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ANNUAL REPORT  
OF THE  
CHIEF OF ENGINEERS,  
UNITED STATES ARMY.

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1907.



WAR DEPARTMENT.

DOCUMENT No. 305.

Office of the Chief of Engineers.

REPORT  
OF  
THE CHIEF OF ENGINEERS,  
UNITED STATES ARMY.

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WAR DEPARTMENT,  
OFFICE OF THE CHIEF OF ENGINEERS,  
*Washington, August 1, 1907.*

SIR: I have the honor to present for your information the following report upon the duties and operations of the Engineer Department for the fiscal year ending June 30, 1907.

OFFICERS OF THE CORPS OF ENGINEERS.

The number of officers holding commissions in the Corps of Engineers, United States Army, at the end of the fiscal year, including 8 who graduated from the Military Academy on June 14, 1907, but were not officially assigned to the Corps of Engineers until July 19, 1907, was 171.

Since the last annual report the Corps of Engineers has lost 7 of its officers—Col. William S. Stanton, who was retired from active service September 9, 1906, by operation of law, under the provisions of the act of Congress approved June 30, 1882; Capt. Robert P. Johnston, who resigned September 17, 1906; Lieut. Col. James L. Lusk, who died September 26, 1906; Col. William R. Livermore, who was retired from active service January 11, 1907, and Col. William H. Heuer, who was retired from active service March 2, 1907, by operation of law, under the provisions of the act of Congress approved June 30, 1882; Lieut. Col. George McC. Derby, who was retired from active service June 7, 1907, under the provisions of section 1243, Revised Statutes, and Col. James B. Quinn, who was retired from active service June 9, 1907, by operation of law, under the provisions of the act of Congress approved June 30, 1882.

There were added to the Corps of Engineers, by promotion of graduates of the Military Academy, 8 second lieutenants on July 19, 1907, to rank from June 14, 1907.

The duties devolving upon the Corps of Engineers have been increased during the past year by the selection of three of its officers, Lieut. Col. George W. Goethals, Maj. David DuB. Gaillard, and Maj. William L. Sibert, as Isthmian Canal Commissioners. Of these, Lieutenant Colonel Goethals is also the chairman of the Commission and the chief engineer of the canal. The detail of Maj.

Edgar Jadwin for duty under the Isthmian Canal Commission, in charge of a division of the canal, occurred during the year. In addition to these new duties, the Corps of Engineers is still charged with the command of three battalions of troops; the construction of fortifications; superintending works of river and harbor improvements; the construction and repair of light-houses; the construction of public buildings; the water supply, the municipal engineering, care of public buildings and grounds, and a share in the city government of the capital of the United States; the improvement of the Yellowstone National Park; the survey of the Northern and Northwestern lakes; the mining and debris commission in the State of California, all of which involve the expenditure of many millions annually, and, in addition to various other duties, supervision of military engineering and reconnaissance work in the several military divisions; instruction at the War College, at the Staff College, at the Military Academy, at schools of application, and membership in the General Staff.

On the 30th of June, 1907, the officers were distributed as follows:

Commanding the Corps of Engineers and Engineer Department, and on Board of Ordnance and Fortification and Inland Waterways Commission	1
Office of the Chief of Engineers	2
Office of the Chief of Engineers and Light-House Board	1
Division engineer	1
The Board of Engineers	1
River and harbor works	19
Fortifications, river and harbor works, and light-house districts	6
Fortifications and river and harbor works	15
Division engineer, The Board of Engineers, and river and harbor works	2
Division engineer, fortifications, and river and harbor works	2
Mississippi River Commission, river and harbor works, and light-house districts	2
Division engineer and river and harbor works	1
Leave of absence	2
General Staff	2
Cuba	15
Philippines Division	12
Division engineer, fortifications, river and harbor works, and light-house district	1
Light-House Establishment	2
Isthmian Canal Commission (one being chief engineer)	3
Division engineer, river and harbor works, and chief engineer officer, Pacific Division	1
Mississippi River Commission and river and harbor works	1
Infantry and Cavalry School and Staff College	4
Post of Fort Leavenworth, Kans., and Third Battalion of Engineers	8
River and harbor works and light-house districts	3
Fortifications, California Débris Commission, and light-house district	1
Post of Washington Barracks, D. C., and Engineer School	15
Northern and Northwestern Lakes and light-house district	1
Public buildings and grounds, District of Columbia	1
Washington Aqueduct, fortifications, and river and harbor works	2
Buildings for War College, Washington Barracks, at the Soldiers' Home, and for the Department of Agriculture	1
Engineer Commissioner, District of Columbia	1
United States Military Academy	10
Post of Fort Mason, Cal., and First Battalion of Engineers	7
Assistant to Engineer Commissioner, District of Columbia	1
En route from Cuba	5
River and harbor works and California Débris Commission	1
River and harbor works and board of road commissioners of Alaska	1
Mississippi River Commission	1
Office Chief of Staff	1
Superintendent State, War, and Navy Department building	1

Yellowstone National Park.....	1
Chief engineer officer, Southwestern Division.....	.1
National Match.....	2
Fortifications of Guantanamo Bay, Cuba.....	1
General Hospital, Fort Bayard, N. Mex.....	1
Graduating leave of absence.....	8
Total .....	171

## THE BOARD OF ENGINEERS.

The regulations for the government of the Corps of Engineers provide for a Board of Engineers, consisting of not less than three officers, designated by the Chief of Engineers, with the sanction of the Secretary of War. This Board acts in an advisory capacity to the Chief of Engineers upon important questions of engineering. One of its principal duties is to plan or revise the projects for permanent fortifications of the United States.

During the fiscal year the Board has reported upon various subjects connected with fortification work.

A statement of the composition of this Board during the past fiscal year will be found in its report.

(See Appendix No. 1.)

## FORTIFICATIONS.

The scheme of national defense upon which work was in progress between 1888 and 1906 was based primarily upon a report submitted January 16, 1886, by the Endicott Board. On January 31, 1905, the President organized a board, with the Secretary of War as president, to review the projects for the United States and for the insular possessions, to indicate the localities where defenses are most urgently needed, and to determine the character and general extent of the defenses, with their estimated cost. The Board submitted its final report February 1, 1906.

Permanent seacoast defenses have been installed at the following localities in the United States:

- |   |  |
|---|--|
| 1. Kennebec River, Maine.                 | 14. Charleston, S. C.                      |
| 2. Portland, Me.                          | 15. Port Royal, S. C.                      |
| 3. Portsmouth, N. H.                      | 16. Savannah, Ga.                          |
| 4. Boston, Mass.                          | 17. Key West, Fla.                         |
| 5. New Bedford, Mass.                     | 18. Tampa Bay, Florida.                    |
| 6. Narragansett Bay, Rhode Island.        | 19. Pensacola, Fla.                        |
| 7. Eastern entrance to Long Island Sound. | 20. Mobile, Ala.                           |
| 8. New York, N. Y.                        | 21. New Orleans, La.                       |
| 9. Delaware River.                        | 22. Galveston, Tex.                        |
| 10. Baltimore, Md.                        | 23. San Diego, Cal.                        |
| 11. Washington, D. C.                     | 24. San Francisco, Cal.                    |
| 12. Hampton Roads, Virginia.              | 25. Columbia River, Oregon and Washington. |
| 13. Cape Fear River, North Carolina.      | 26. Puget Sound, Washington.               |

In accordance with the report of the Board above mentioned, additional defenses are to be constructed at some of these points, and also at the entrance to Chesapeake Bay, as soon as funds are provided by Congress.

Appropriations for construction of gun and mortar batteries have been made as follows:

Act of—		Act of—	
August 18, 1890.....	\$1, 221, 000. 00	May 7, 1898.....	\$3, 000, 000. 00
February 24, 1891.....	750, 000. 00	July 7, 1898.....	2, 562, 000. 00
July 23, 1892.....	500, 000. 00	March 3, 1899.....	1, 000, 000. 00
February 18, 1893.....	50, 000. 00	May 25, 1900.....	2, 000, 000. 00
August 1, 1894.....	500, 000. 00	March 1, 1901.....	1, 615, 000. 00
March 2, 1895.....	500, 000. 00	June 6, 1902.....	2, 000, 000. 00
June 6, 1896.....	2, 400, 000. 00	March 3, 1903.....	2, 236, 425. 00
March 3, 1897.....	3, 841, 333. 00	April 21, 1904.....	700, 000. 00
Allotments from the ap- propriation for "Na- tional Defense," act of March 9, 1898.....	3, 817, 676. 02	Total.....	28, 693, 434. 02

The following table shows the present status of permanent work completed or in progress with funds already provided:

Calibers.	Total number carried by scheme of National Coast Defense Board.	Provided for by appropriations made by Congress.
12-inch mortars .....	464	376
16-inch rifles .....	1	.....
14-inch rifles .....	19	.....
12-inch rifles .....	138	105
10-inch rifles .....	139	133
8-inch rifles .....	72	70
6-inch rapid-fire guns .....	191	171
5-inch rapid-fire guns .....	53	58
4.7-inch and 4-inch rapid-fire guns.....	38	38
3-inch rapid-fire guns .....	284	254

For the engineer work involved in the completion of the defenses recommended by the Board constituted by Executive order of January 31, 1905, it is estimated that \$16,052,431 will be required.

Since April 21, 1904, no appropriation has been made for the construction of gun and mortar batteries. The construction of emplacements, which had been begun under appropriations made up to that time, has continued under the original allotments, and as the estimates were accurate the balances on hand will be sufficient to complete them all.

At the close of the fiscal year the status of emplacements for which funds have been provided by Congress is as follows:

	12-inch mortars.	12-inch.	10-inch.	8-inch.	Rapid- fire.
Guns mounted .....	376	105	<i>a</i> 122	<i>b</i> 94	<i>c</i> 455
Ready for armament .....	.....	.....	11	5	<i>d</i> 130
Under construction .....	.....	.....	.....	.....	2
Total .....	376	105	133	99	587

<sup>a</sup> Including original experimental 10-inch carriage.

<sup>b</sup> Including 26 which have been dismantled since the war with Spain and 3 which are now temporarily mounted.

<sup>c</sup> One temporarily.

<sup>d</sup> Including 70 6-pounders not requiring permanent emplacements.

At the close of the previous fiscal year there were reported mounted:

12-inch mortars.	12-inch.	10-inch.	8-inch.	Rapid-fire.
375	105	119	94	325

A comparison of the last two tables shows an increase during the year in guns actually available for service of 1 mortar, 3 10-inch guns, and 130 rapid-fire guns.

The following table shows that the Engineer and Ordnance departments have worked in harmony, the numbers of gun carriages and emplacements being the same, except where extra carriages are needed for purposes other than seacoast defense:

Type of gun or carriage.	Total carriages provided.	Total emplacements provided.
12-inch mortar carriages, model 1896 .....	a 306	296
12-inch mortar carriages, model 1891 .....	b 85	80
12-inch disappearing carriages, L. F., model 1901 .....	11	11
12-inch disappearing carriages, L. F., model 1897 .....	35	35
12-inch disappearing carriages, L. F., model 1896 .....	27	27
12-inch gun-lift carriages, altered to nondisappearing .....	3	3
12-inch gun-lift carriages, model 1891 .....	2	2
12-inch nondisappearing carriages, model 1892 .....	c 28	27
10-inch disappearing carriages, A. R. F., model 1896 .....	3	3
10-inch disappearing carriages, L. F., model 1901 .....	12	12
10-inch disappearing carriages, L. F., model 1896 .....	74	74
10-inch disappearing carriages, L. F., model 1894 .....	d 35	35
10-inch nondisappearing carriages, model 1893 .....	e 10	9
8-inch disappearing carriages, L. F., model 1896 .....	38	40
8-inch disappearing carriages, L. F., model 1894 .....	26	26
8-inch nondisappearing carriages, model 1892 .....	f 9	9
15-inch smoothbore carriages altered for 8-inch rifles .....	21	h 21
6-inch disappearing carriages, model 1898 .....	29	29
6-inch rapid-fire (Vickers Son & Maxim), pedestal mounts .....	8	8
6-inch disappearing carriages, model 1903 .....	90	90
6-inch rapid-fire, pedestal mounts, model 1900 .....	45	44
5-inch balanced-pillar mounts, model 1896 .....	32	32
5-inch pedestal mounts, model 1903 .....	21	21
4.7-inch rapid-fire (Armstrong pattern), pedestal mounts .....	34	34
4.7-inch rapid-fire (Schneider pattern), pedestal mount .....	1	i 1
4-inch rapid-fire (Driggs-Schroeder), pedestal mounts .....	4	4
3-inch balanced-pillar mounts .....	114	114
3-inch casemate mounts .....	2	2
3-inch pedestal mounts, model 1902 .....	60	60
3-inch pedestal mounts, model 1903 .....	78	78
2.24-inch rapid-fire field carriages and rampart mounts .....	70	(j)

<sup>a</sup> The number of carriages of this type provided for exceeds by 10 the number which the Chief of Engineers has notified the Chief of Ordnance are required for the emplacements he has provided.

<sup>b</sup> One in use at West Point; 4 in storage.

<sup>c</sup> One in use at Sandy Hook Proving Ground.

<sup>d</sup> One carriage is the original experimental one for this caliber of gun, and has been put out of service at the instance of the Artillery Corps.

<sup>e</sup> One at Sandy Hook Proving Ground. The number of carriages of this type provided for exceeds by 1 the number which the Chief of Engineers has notified the Chief of Ordnance are required for the emplacements he has provided.

<sup>f</sup> One at West Point and one at Sandy Hook Proving Ground.

<sup>g</sup> Five temporary; armament removed from 3.

<sup>h</sup> Temporary; armament removed from 20.

<sup>i</sup> Temporary.

<sup>j</sup> Movable mounts.

For continuing the construction of gun and mortar batteries in accordance with the present plans, an estimate of \$4,247,400 is submitted.

*Modernizing older emplacements.*—For these improvements an estimate of \$942,500 was submitted in 1904. Appropriations have

been made for the last three years, aggregating the sum of \$700,000. This sum is being applied to the most urgently needed betterments.

The appropriation of \$242,500, the balance of the original estimate, is recommended, and an estimate of that amount has been submitted.

In the annual estimates submitted to the Secretary of War for transmission to Congress, authority has also been asked to apply the sum of \$165,261.36, formerly appropriated for the construction of pneumatic dynamite batteries (now remaining unspent, due to the abandonment of that form of ordnance), to the initiation of mechanical powder service, the need for which has developed since the estimate of \$942,500 was prepared.

*Electrical installations.*—The National Coast Defense Board estimated that \$5,216,031 would be required to furnish the necessary electrical equipment for the defenses of the United States in addition to the current required for searchlights. No funds have been appropriated since the act of April 21, 1904, which are applicable to the installation of electrical plants for the service of the batteries. In order to begin the installation of this necessary equipment, an estimate of \$1,000,000 is submitted.

*Fire control at fortifications.*—The fortification act, approved June 25, 1906, provided the sum of \$700,000 for this purpose, to be distributed in the discretion of the Secretary of War among the Engineer and Ordnance departments and the Signal Corps. Of this amount the sum of \$217,631.37 was assigned to the Engineer Department. Engineer work is now in progress with these funds and will be well advanced by the close of the present working season.

The fortification act of March 2, 1907, provided the sum of \$900,000 for this purpose, of which \$432,784.81 were assigned to the Engineer Department, and before June 30, 1907, construction had begun.

An estimate of \$1,685,750 to cover the work of the Engineer and Ordnance departments and the Signal Corps under this head for the next fiscal year is submitted by the Chief of Artillery.

*Sites for fortifications.*—During the past year a site has been acquired at Boston, Mass., a part of the purchase money being withheld, in accordance with the terms of the sale, until a wall separating the tract acquired from adjacent ground has been built by the city of Boston.

No funds have been provided since the act of April 21, 1904, for this purpose. A number of sites are to be acquired to carry out the approved projects of seacoast defenses, and an estimate of \$3,478,500 is submitted for the acquisition of such sites as may be desirable in the near future.

*Searchlights.*—With the appropriation of \$210,000 contained in the fortification appropriation act approved March 2, 1907, it is proposed to procure by contract a number of searchlight outfits for distribution to as many forts as the funds will permit. The specifications for these outfits are now in course of preparation, and investigations are being made as to the best type of generators and projectors. The need at all defended harbors of an adequate supply of powerful searchlights has been fully demonstrated by the various exercises and maneuvers of the artillery. The Chief of Engineers and the Chief of Artillery are entirely in accord in the view that systematic installation of such apparatus for night defense should continue.

For the purchase and installation of additional searchlight outfits an estimate of \$1,000,000 is submitted. The National Coast Defense Board, constituted by Executive order of January 31, 1905, estimated the cost of sufficient searchlights for the coast of the United States as \$2,987,700, without any provision for reserves.

*Preservation and repair of fortifications.*—The modern works of defense now constructed represent an expenditure of approximately \$28,000,000 for engineering work alone. For the preservation and repair of these works during the present fiscal year there was appropriated the sum of \$200,000, less than 1 per cent of the cost of construction. These extensive works are composed of iron, which is peculiarly subject to the deteriorating effect of damp sea air, and of concrete, which in large masses is affected by temperature changes, causing cracks, of no importance if promptly closed, but admitting water to the interior rooms where is located much costly machinery—electrical, conveying, and hoisting. The \$200,000 appropriated in the act of March 2, 1907, are not sufficient to keep the essential features of the fortifications in satisfactory condition. To keep the fortifications in effective condition an average expenditure of not less than \$25,000 per month is essential. With that sum depreciation can be made very small in the 1,200 emplacements—a cost of \$20.83 only per month per gun.

An estimate of \$300,000 for preservation and repair is submitted, and it is strongly recommended (in the interest of economy and efficient service) that this amount be appropriated.

*Repairs and protection at defenses of Charleston, Pensacola, Mobile, and New Orleans.*—For repairs and sea walls at these localities, rendered necessary by storms, the following estimates were submitted to Congress at its last session:

Charleston, S. C., for the construction of the sea wall necessary for the protection of Fort Moultrie.....	\$225,600
Pensacola, Fla., for building sea walls for the protection of the sites of the fortifications and of the necessary post buildings at Forts Pickens and McRee.....	907,100
Pensacola, Fla., for repair and restoration of batteries and other structures appurtenant to the defenses of Pensacola, and for retaining walls to protect the batteries from floods.....	109,355
Mobile, Ala., for repair and restoration of batteries and other structures appurtenant to the defenses of Mobile, and for rebuilding sea walls and groins for protection of the sites of the fortifications of the garrison posts.....	1,089,500
New Orleans, La., for rebuilding and strengthening the levees for protection of the site of the defenses and the garrison post at Fort St. Philip.....	139,800

#### Appropriations were made as follows:

Charleston, Fort Moultrie, "Toward the construction" of sea wall....	\$100,000
Pensacola, "Toward the building" of sea walls.....	400,000
Pensacola, "Toward the repair and restoration" of the defenses.....	50,000
Mobile, "Toward the repair and restoration" of the defenses.....	500,000
New Orleans, Fort St. Philip, "For rebuilding and strengthening the levees".....	100,000

Except in the case of Fort St. Philip, limits identical with the estimates were specified also in the act, although only a portion of the money was appropriated.

For the completion of the work above authorized by Congress it is



recommended that the balances of the original estimates be appropriated as follows:

Fort Moultrie, S. C.-----	\$125, 600
Pensacola, for sea walls-----	507, 100
Pensacola, for repair and restoration of defensive works-----	59, 355
Mobile, Ala-----	589, 500

At Fort St. Philip, New Orleans, \$100,000 were appropriated, but authority to initiate the proposed protective levees in their entirety was not given. A portion of the reservation will therefore be protected, and the balance abandoned to overflow until further funds are available. Floods are higher than formerly, due to the building of levees below the forts. It is estimated that \$40,000 will be required to render the Fort St. Philip reservation reasonably safe against floods in future, and an estimate of that amount is submitted.

*Supplies for seacoast defenses.*—Owing to the large number of electric installations supplying power and light in seacoast batteries, funds have been appropriated annually for the past eight years for "tools and electrical and engine supplies for use of the troops for maintaining and operating light and power plants in gun and mortar batteries." This appropriation is designed to enable the Engineer Department to comply with the regulations of the War Department for the supply and service of the batteries. Requisitions are made upon the Chief of Engineers, through the district engineer officers, and authorized articles are purchased and issued by district engineer officers with as little delay as possible. This system has proved eminently satisfactory to the garrisons.

The amount appropriated for this purpose in the act approved March 2, 1907, was \$40,000. The regular issues call for an average expenditure of \$3,333 a month.

To furnish the supplies actually needed during the next fiscal year it is estimated that \$40,000 will be required, and an estimate of this amount is submitted.

*Sea walls and embankments.*—The sum of \$25,000 was appropriated for this purpose by the fortification appropriation act approved March 2, 1907. This amount is being applied to such work only as becomes urgently necessary for the protection of the defensive works.

Based upon detailed estimates prepared by district engineer officers, an estimate of \$180,000 is submitted for the construction of sea walls and embankments at a number of localities on the Atlantic and Gulf coasts, where they are needed to protect the defenses.

*Sea walls, defenses of Galveston, Tex.*—The defensive works at Galveston were unavoidably in most exposed positions, and the level of the lands surrounding the batteries was greatly lowered by the storm of September 8, 1900. Work of reconstruction and repair of the Galveston defenses is now approaching completion under the appropriation contained in the fortification act approved March 1, 1901. With the funds so provided, and in accordance with the plans before Congress when that appropriation was made, each individual battery has been made secure against any similar storms which are likely to occur in the future, but no provision has been made to protect the sites on which quarters, barracks, and other post buildings must be located, except at Fort Crockett. For building a sea wall and

filling up the reservation at this fort to a height above storm tides the sums of \$591,046.25 and \$158,953.75 were appropriated in the sundry civil appropriation acts of April 28, 1904, and June 30, 1906, aggregating \$750,000. Under the latter appropriation the work at Fort Crockett is now being completed.

For similar protection and fill at Forts San Jacinto and Travis detailed estimates have been prepared by the district engineer officer, amounting to \$925,000 and \$350,000, respectively. Such protection is necessary for the garrisons required, and the estimates of the district officer are submitted for the consideration of Congress.

*Preservation and repair of torpedo structures.*—A large number of new torpedo-defense structures have been completed, and a number, in addition, are approaching completion. An estimate of \$50,000 is submitted for the preservation and repair of these very numerous buildings. The appropriations made to date for building torpedo structures aggregate \$2,128,000, and it is believed that the above estimate for maintenance is reasonable when considered in connection with the original cost of the buildings.

The appropriation act of March 2, 1907, contained an item of \$10,000 for this purpose. This sum is being applied to such minor repairs as are found from time to time to be most urgently necessary.

*Submarine mines.*—While the operation of torpedo defenses is the duty of the Coast Artillery Corps, the building of structures required in connection therewith is under the charge of the Engineer Department.

To complete the engineer structures for the torpedo defenses recommended by the National Coast Defense Board, except at the entrance to Chesapeake Bay and at Galveston, Tex. (where, owing to the present status of the defenses and garrison posts, it is not considered advisable to build the torpedo structures immediately), an estimate of \$464,964 is submitted, in accordance with the request of the Chief of Artillery.

The sum of \$175,000 provided in the fortification act of March 2, 1907, is being applied in accordance with the artillery scheme.

*Batteries in insular possessions.*—The first appropriation for this purpose was contained in the fortification act approved April 21, 1904, and additional appropriations have been made in each of the three succeeding years, the aggregate amount appropriated to date being \$2,360,000. With these appropriations work is being prosecuted at Guantanamo Bay, Cuba; Honolulu and Pearl Harbor, Hawaii, and Manila and Subic Bay, Philippine Islands.

The defense of the important harbors of the insular possessions has been specially considered by the National Coast Defense Board, and any funds appropriated for batteries will be applied in accordance with the general projects of that Board. For the construction of batteries to be begun next year an estimate of \$8,618,000 is submitted, \$1,020,000 to be applied to the defense of the naval station at Guantanamo Bay, Cuba, \$1,110,000 to Honolulu and Pearl Harbor, Hawaii, and \$6,488,000 to Manila, P. I.

*Electrical installations, insular possessions.*—The National Coast Defense Board estimated that \$788,713 would be required to furnish the necessary electrical equipment for the defenses of the insular possessions, in addition to the current required for searchlights. In

order to begin the installation of this equipment, an estimate of \$502,992 is submitted, \$103,727 for Guantanamo Bay, \$34,469 for Honolulu and Pearl Harbor, \$259,080 for Manila, and \$105,716 for Subic Bay.

*Searchlights, insular possessions.*—For this purpose the sum of \$30,000 was appropriated in the act of March 2, 1907. This is now under contract. For the purchase and installation of searchlights at the defenses of the insular possessions, an estimate of \$500,000 is submitted, \$84,000 to be applied to Guantanamo Bay, Cuba, \$57,000 to San Juan, P. R., \$95,000 to Pearl Harbor and Honolulu, Hawaii, \$57,000 to Guam, \$95,000 to Subic Bay, Philippine Islands, and \$114,000 to Manila, P. I.

*Submarine mines, insular possessions.*—The fortification act of March 2, 1907, provided the sum of \$200,000 for this purpose. This sum is being applied in accordance with the recommendations of the Chief of Artillery.

For this purpose the sum of \$129,000 can be advantageously used during the next fiscal year, and an estimate of that amount is submitted, to be applied at Honolulu and Pearl Harbor, Hawaii.

*Fire control at batteries in insular possessions.*—The fortification act of March 2, 1907, provided \$100,000 for this purpose, which sum was available for the work of the Engineer and Ordnance departments and the Signal Corps. Of this appropriation the sum of \$75,000 is being applied to work of the Engineer Department involved in equipping the batteries most in need of fire-control systems.

A number of batteries requiring range-finder service are, or will soon be, completed, and it is important for their efficiency that they be equipped with fire-control systems. The estimate for this work will, it is understood, be submitted by the Chief of Artillery.

The following money statements show the condition on June 30, 1907, of all general appropriations under which operations were in progress at the close of the fiscal year:

“GUN AND MORTAR BATTERIES.”

*For battery construction.*

July 1, 1906, balance unallotted	\$100,924.31
June 30, 1907, net allotments during the fiscal year	43,139.96
July 1, 1907, balance unallotted	57,784.35
July 1, 1907, amount pledged	57,784.35

*For modernizing older emplacements.*

July 1, 1906, balance unallotted	\$184,926.50
March 2, 1907, appropriated	100,000.00
	284,926.50
June 30, 1907, net allotments during the fiscal year	274,140.55
July 1, 1907, balance unallotted	10,785.95

*For installation of range and position finders.*

July 1, 1906, balance unallotted	\$4,075.61
June 30, 1907, net allotments during the fiscal year	4,075.61

## "FIRE CONTROL AT FORTIFICATIONS."

July 1, 1906, balance unallotted	\$985. 98
November 1, 1906, assigned to the Engineer Department from the act of June 25, 1906	217, 631. 37
April 5, 1907, assigned to the Engineer Department from the act of March 2, 1907	432, 784. 81
	<hr/>
June 30, 1907, net allotments during the fiscal year	651, 402. 16
	562, 569. 34
July 1, 1907, balance unallotted	88, 832. 82
July 1, 1907, amount pledged	88, 832. 82

## "SITES FOR FORTIFICATIONS AND SEACOAST DEFENSES."

July 1, 1906, balance unallotted	\$353, 176. 59
June 30, 1907, net allotments during the fiscal year	303, 554. 53
July 1, 1907, balance unallotted	49, 622. 06
July 1, 1907, amount pledged	49, 622. 06

## "SEARCHLIGHTS FOR HARBOR DEFENSES."

July 1, 1906, balance unallotted	\$125, 000. 00
March 2, 1907, amount appropriated	210, 000. 00
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June 30, 1907, net allotments during the fiscal year	335, 000. 00
	19, 863. 56
July 1, 1907, balance unallotted	315, 136. 44
July 1, 1907, pledged	215, 000. 00
July 1, 1907, balance available for additional outfits	100, 136. 44

## "PRESERVATION AND REPAIR OF FORTIFICATIONS."

July 1, 1906, balance unallotted	\$208, 224. 38
March 2, 1907, amount appropriated	200, 000. 00
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June 30, 1907, net allotments during the fiscal year	408, 224. 38
	408, 224. 38

## "PLANS FOR FORTIFICATIONS."

July 1, 1906, balance unallotted	\$5, 000. 00
March 2, 1907, amount appropriated	5, 000. 00
	<hr/>
June 30, 1907, net allotments during the fiscal year	10, 000. 00
	10, 000. 00

## "SUPPLIES FOR SEACOAST DEFENSES."

July 1, 1906, balance unallotted	\$30, 000. 00
March 2, 1907, amount appropriated	40, 000. 00
	<hr/>
June 30, 1907, net allotments during the fiscal year	70, 000. 00
	64, 479. 00
July 1, 1907, balance unallotted	5, 521. 00
July 1, 1907, amount pledged	957. 00
July 1, 1907, balance available for allotment during the fiscal year	4, 564. 00

## "SEA WALLS AND EMBANKMENTS."

July 1, 1906, balance unallotted.....	\$50,631.92
March 2, 1907, amount appropriated.....	25,000.00
	<hr/>
	75,631.92
June 30, 1907, net allotments during the fiscal year.....	69,419.26
	<hr/>
July 1, 1907, balance available for emergencies during the fiscal year.....	6,212.66

## "PRESERVATION AND REPAIR OF TORPEDO STRUCTURES."

July 1, 1906, balance unallotted.....	\$10,000.00
March 2, 1907, amount appropriated.....	10,000.00
	<hr/>
	20,000.00
June 30, 1907, net allotments during the fiscal year.....	19,715.27
	<hr/>
July 1, 1907, balance available.....	284.73

## "CASEMATES, GALLERIES, ETC., FOR SUBMARINE MINES."

July 1, 1906, balance unallotted.....	\$176,053.23
March 2, 1907, amount appropriated.....	175,000.00
	<hr/>
	351,053.23
June 30, 1907, net allotments during the fiscal year.....	250,854.06
	<hr/>
July 1, 1907, balance unallotted.....	100,199.17
July 1, 1907, amount pledged.....	100,199.17

## "FORTIFICATIONS IN INSULAR POSSESSIONS."

*For construction of seacoast batteries.*

July 1, 1906, balance unallotted.....	\$260,000.00
March 2, 1907, amount appropriated.....	700,000.00
	<hr/>
	960,000.00
June 30, 1907, net allotments during the fiscal year.....	455,293.74
	<hr/>
July 1, 1907, balance unallotted.....	504,706.26
July 1, 1907, amount pledged.....	504,706.26

*For sites, Hawaiian Islands.*

July 1, 1906, balance unallotted.....	\$151,662.00
June 30, 1907, net allotments during the fiscal year.....	236.49
	<hr/>
July 1, 1907, balance unallotted.....	151,425.51
July 1, 1907, amount pledged.....	151,425.51

*For searchlights.*

March 2, 1907, amount appropriated.....	\$30,000.00
June 30, 1907, net allotments during the fiscal year.....	12,037.00
	<hr/>
July 1, 1907, balance unallotted.....	17,963.00
July 1, 1907, amount pledged.....	17,963.00

*For casemates, galleries, etc., for submarine mines.*

March 2, 1907, amount appropriated.....	\$200,000.00
June 30, 1907, net allotments during the fiscal year.....	200,000.00

## "FIRE CONTROL IN INSULAR POSSESSIONS."

March 2, 1907, portion of appropriation assigned to the Engineer Department-----\$75,000.00  
 July 1, 1907, amount pledged-----75,000.00

## ESTIMATES OF APPROPRIATIONS REQUIRED FOR 1908-9 FOR FORTIFICATIONS.

## Gun and mortar batteries:

For construction of gun and mortar batteries \$4,247,400.00  
 For modernizing older emplacements-----242,500.00  
 \$4,489,900.00

Electrical installations at seacoast fortifications-----1,000,000.00

Sites for fortifications and seacoast defenses-----3,478,500.00

Searchlights for harbor defenses-----1,000,000.00

Preservation and repair of fortifications-----300,000.00

Sea wall, Fort Moultrie, S. C.-----125,600.00

## Repair and protection of defenses of Pensacola, Fla.:

For sea walls-----\$507,100.00

For repairs to batteries, etc.-----59,355.00

566,455.00

Repair and protection of defences of Mobile, Ala.-----589,500.00

Repair and protection of defenses at New Orleans, La.-----40,000.00

Plans for fortifications-----5,000.00

Supplies for seacoast defenses-----40,000.00

Sea walls and embankments-----180,000.00

## Sea walls, defenses of Galveston, Tex.:

For Fort San Jacinto-----\$925,000.00

For Fort Travis-----350,000.00

1,275,000.00

Preservation and repair of torpedo structures-----50,000.00

Casemates, galleries, etc., for submarine mines-----464,964.00

Experimental automobile torpedoes-----100,000.00

## Fortifications in insular possessions:

## For seacoast batteries—

Guantanamo Bay, Cuba-----\$1,020,000.00

Honolulu and Pearl Harbor-----1,110,000.00

Manila, P. I.-----6,488,000.00

## For installation of electric plants—

Guantanamo Bay, Cuba-----103,727.00

Honolulu and Pearl Harbor-----34,469.00

Manila, P. I.-----259,080.00

Subic Bay, Philippine Islands-----105,716.00

## For searchlights—

San Juan, P. R.-----57,000.00

Guantanamo Bay, Cuba-----84,000.00

Pearl Harbor and Honolulu-----95,000.00

Guam-----57,000.00

Subic Bay, Philippine Islands-----95,000.00

Manila, P. I.-----114,000.00

## For torpedo structures at defenses of Honolulu and Pearl Harbor, Hawaii-----

129,000.00

## For sites for fortifications in the Philippine Islands-----

5,000.00

9,756,992.00

Total-----23,461,911.00

ENGINEER DEPOTS AT WASHINGTON BARRACKS,  
 DISTRICT OF COLUMBIA, FORT LEAVENWORTH,  
 KANSAS, AND FORT MASON, CALIFORNIA.

Officers in charge: Depot at Washington Barracks, Maj. William C. Langfitt, Corps of Engineers, until November 30, 1906, and Maj. E. Eveleth Winslow, Corps of Engineers, since that date; depot at Fort Leavenworth, Maj. Thomas H. Rees, Corps of Engineers, and depot at Fort Mason, Capt. Meriwether L. Walker, Corps of Engineers.

## ENGINEER DEPOT, WASHINGTON BARRACKS.

This depot is the repository for part of the military bridge equipage of the Army; for miscellaneous military engineering tools, supplies, and materials of all kinds, and for astronomical, surveying, drafting, and reconnaissance instruments and supplies used by the Army and by officers of the Corps of Engineers on public works, both military and civil. It purchases and issues military engineering tools and supplies and serves particularly as an exchange for engineer instruments of all kinds, receiving them from the Army or public works, caring for them while in store, causing to be made the necessary repairs, reissuing them when required, and, so far as limited appropriations will permit, making purchases of such items as can not be supplied from store.

The general work of the depot consisted of care of the property on hand, purchase of new articles, and shipment to troops of supplies as needed. During nearly the entire year the engineer troops forming the regular garrison of the post were absent at maneuver camps or in Cuba, consequently the work of the depot was carried on entirely by civilian employees. Owing to the nonavailability of the enlisted men for detail on extra duty in the depot, the force of civilian employees was slightly enlarged, but was at all times kept down to the minimum necessary. The large requisitions received increased the work considerably, and it is believed to have exceeded that of any previous year, the total weight of supplies shipped being estimated at approximately 195,000 pounds. Much work was entailed in fitting out engineer troops for maneuver camps and for duty in Cuba and the Philippines, and in filling requisitions from the organized militia of the States of New York, Indiana, Texas, and Oklahoma.

The new depot storehouse was completed. The old building used for various shops pertaining to the depot and for other purposes connected with the Engineer School is to be demolished at an early date. As the shops are a most essential part of the depot, a new building should be provided for immediately. An estimate for this building is included in the estimates to be submitted to Congress at its next session. There is no available place on the post for the storage of the various wagons pertaining to the bridge trains, and the space available for the storage of miscellaneous lumber and bridge material is far too small. These imperative needs of the depot should be attended to at an early date. Roughly estimated, the construction of such a shed for the protection of ponton wagons and other heavy bulky ponton material, and for protecting all sorts of lumber used at the depot for various purposes would cost about \$12,500; an estimate for this structure will also be included in the estimates to be submitted to Congress at its next session.

## ENGINEER DEPOT, FORT LEAVENWORTH.

This depot is maintained for the purpose of issuing supplies to the battalion of engineers there stationed and for the storage, repair, and manufacture of ponton material. The shops were in operation from the beginning of the fiscal year until July 15, 1906, preparing the equipment for the battalion for the maneuvers at Fort Riley and

overhauling and fitting out the ponton trains. Upon the departure of the battalion for Fort Riley the shops and storehouses were closed, and continued so during the remainder of the year owing to the absence of the battalion at Fort Riley and in Cuba. Since March, 1907, a laborer has been employed in the depot arranging and caring for the property. Minor repairs were made and paint applied to the steamer *Unique*. Ways and cradle were built and preparations made for hauling out the boat for thorough repairs.

## ENGINEER DEPOT, FORT MASON.

The ponton equipment was put in a serviceable condition, barring a slight shortage of balk and chess. Anchors, boat pumps, and anchor lines were purchased; nothing was done with the wagons, as they were practically worthless. Companies C and D, First Battalion of Engineers, were furnished with such expendable supplies as were needed for instruction. The depot was maintained, enlisted men being employed on extra duty as overseer, mechanics, and photographer.

The details of the operations of the depots, including purchase, issue, and care of all stores, will be found in the reports of the officers in charge.

## ENGINEER DEPOTS, 1907.

*Incidentals.*

Amount appropriated in the army appropriation act of June 12, 1906	\$11,500.00
June 30, 1907, amount expended during fiscal year	8,973.27
July 1, 1907, balance unexpended	2,526.73
July 1, 1907, outstanding liabilities	2,401.57
July 1, 1907, balance to revert to Treasury	125.16

*Instruments.*

Amount appropriated in the army appropriation act of June 12, 1906	\$5,000.00
June 30, 1907, amount expended during fiscal year	3,641.80
July 1, 1907, balance unexpended	1,358.20
July 1, 1907, outstanding liabilities	1,358.20

## ESTIMATES OF APPROPRIATIONS REQUIRED FOR THE ENGINEER DEPOTS FOR 1908-9.

For incidental expenses of the depots, including fuel, lights, chemicals, stationery, hardware, machinery, pay of civilian clerks, mechanics, and laborers, extra-duty pay to soldiers necessarily employed for periods not less than ten days as artificers on work in addition to and not strictly in the line of their military duties, such as carpenters, blacksmiths, draftsmen, printers, lithographers, photographers, engine drivers, telegraph operators, teamsters, wheelwrights, masons, machinists, painters, overseers, laborers, repairs of, and for materials to repair, public buildings and machinery, and unforeseen expenses	\$11,500.00
For purchase and repair of instruments, to be issued to officers of the Corps of Engineers and to officers detailed and on duty as acting engineer officers for use on public works and surveys	5,000.00
Total	16,500.00

(See Appendixes 2, 3, and 4.)



## ENGINEER EQUIPMENT OF TROOPS.

By the act of Congress approved June 12, 1906, the sum of \$40,000 was appropriated for the procurement of ponton material, tools, instruments, and supplies required for use in the engineer equipment of troops in the field. This appropriation was limited to the fiscal year 1907.

With these funds engineering supplies were furnished, mainly through the United States engineer depots, for the various military divisions and departments in the United States and the Philippines and for the army of pacification in Cuba; the engineer troops were supplied, so far as possible, with the company equipment called for by General Orders, No. 9, Office Chief of Engineers, 1906; and the purchase and issue of reconnaissance outfits to military posts and organizations required by General Orders, No. 24, War Department, 1905, as amended by General Orders, No. 73, War Department, 1907, was continued.

The demand for the Engineer Field Manual, previously published in six separate parts, has continued, and it having been found necessary to provide additional copies, it was decided, with the approval of the chief of staff, to prepare a revised edition, bringing the subject-matter in certain respects up to date, and consolidating the separate parts into a single cover. The preparation of additional matter, text, and plates has been in progress and is substantially completed. The copy for the new edition would have been sent to the printer before the close of the fiscal year had there not been delay incurred in waiting for some results of work, and some experiments with equipment, in connection with the military occupation of Cuba.

It is expected that the delayed matter will be ready so that the work can go to press early in the fiscal year 1908.

Approximately \$20,000 was allotted for the improvement of the authorized bridge equipage. Numerous repairs were made to the material on hand; 3 battery and forge wagons were purchased from the Ordnance Department; contract was entered into for the construction of 37 chess wagons, to be delivered early in the fiscal year 1908, and a quantity of lumber was purchased for balk, chess, and trestles.

The following experimental items of bridge equipment were also purchased: One steel ponton boat; 60 waterproof floats, invented by Capt. A. I. Poliansky, Russian army, retired, and 2 new style canvas ponton covers, made of Con-Ser-Vit olive drab duck.

The army appropriation act of March 2, 1907, provided \$40,000 for the engineer equipment of troops during the fiscal year ending June 30, 1908. In accordance with the estimates submitted to Congress, this amount has been allotted in the following proportions: Twenty thousand dollars for bridge equipage; \$13,000 for the purchase and issue of reconnaissance outfits to the companies, troops, batteries, and posts of the Army, and for the equipment of engineer companies, and \$7,000 for the investigation and purchase of a field searchlight outfit.

For the same purposes during the next fiscal year an estimate of \$40,000 is submitted.

For details of expenditures under the appropriation for engineer equipment of troops see Appendixes 2, 3, and 4.

## ENGINEER EQUIPMENT OF TROOPS, 1907.

Amount appropriated in the army appropriation act of June 12, 1906.....	\$40,000. 00
Amount received during year by settlements and deposits in payment for property transferred, sold, and lost .....	6,339. 31
June 30, 1907, amount expended during fiscal year.....	\$46,339. 31 23,828. 91
July 1, 1907, balance unexpended.....	22,510. 40
July 1, 1907, outstanding liabilities.....	22,434. 99
Balance deposited in Treasury.....	75. 41

## CIVILIAN ASSISTANTS TO ENGINEER OFFICERS.

By act of Congress approved June 12, 1906, the sum of \$25,000 was appropriated for civilian assistants to engineer officers serving on the staffs of division, corps, and department commanders, to enable them to secure the services of surveyors, draftsmen, photographers, master laborers, and clerks during the fiscal year 1907. These funds have been applied to the purpose for which appropriated; the sum of \$24,441.15 was expended during the fiscal year, and a balance of \$558.85 reverted to the Treasury.

The army appropriation act of March 2, 1907, provided \$25,000 for the same purpose during the fiscal year ending June 30, 1908, and an estimate of the same amount is submitted for the fiscal year 1909.

## RIVER AND HARBOR IMPROVEMENTS.

*Appropriations.*—The funds with which the works for the improvement of rivers and harbors were prosecuted during the past fiscal year were derived from the appropriations made by the river and harbor act and sundry civil act approved March 3, 1905, the river and harbor act approved March 2, 1907, the sundry civil act approved March 4, 1907, from such appropriations as have been provided by other general acts and by special acts of Congress, and from the available balances of former appropriations.

The following works are provided for by permanent appropriations: Removing sunken vessels; operating and care of dredge boats on upper Mississippi River; removing obstructions in Mississippi River; gauging waters of the Mississippi River and its tributaries; examinations and surveys at South Pass, Mississippi River; maintenance of South Pass channel, Mississippi River; operating snag boats on Ohio River; operating and care of canals, etc.; support and maintenance of the Permanent International Commission of the Congresses of Navigation.

*Status of works.*—Statements derived from the reports of the officers in charge of the various works, and given herewith, set forth the condition of each improvement and the extent of the work performed during the past fiscal year.

*Expenditures.*—The total amount actually expended under the direction of the Chief of Engineers in connection with the improve-

ment of rivers and harbors during the fiscal year ending June 30, 1907, is as follows:

Rivers and harbors (general, including examinations, surveys, and contingencies)-----	\$19,890,034.71
Removing sunken vessels-----	52,083.87
Operating snag and dredge boats on upper Mississippi River----	25,000.00
Removing obstructions in Mississippi River-----	87,553.65
Gauging waters of the Mississippi River and its tributaries----	7,189.60
Maintenance of South Pass channel, Mississippi River-----	149,759.43
Examinations and surveys at South Pass, Mississippi River----	8,929.88
Operating snag boats on Ohio River-----	35,764.13
Operating and care of canals, etc-----	1,441,390.88
Prevention of deposits in New York Harbor-----	80,787.66
California Débris Commission (expenses)-----	18,478.97
Permanent International Commission of the Congresses of Navigation-----	1,716.38
International Waterways Commission-----	20,552.87
Commission on waterway connecting Chesapeake and Delaware bays-----	9,393.24
	<hr/>
	21,828,634.67

This amount does not include the following:

Expenditures under Mississippi River Commission-----	\$1,623,436.83
Enlargement of Governors Island, New York Harbor-----	74,649.00
Reclamation of Quarantine Island, Honolulu, Hawaii-----	16,125.81
Destruction of ice gorge in Missouri River-----	370.85
Construction of piers in Hampton Roads at the Jamestown Exposition and pier at Jamestown Island, Virginia-----	261,074.76
Funds contributed by citizens of St. Joseph, Mo., for improvement of Missouri River-----	3,806.72
Funds contributed by citizens of Dallas, Tex., for improvement of Trinity River, Texas-----	7,076.47
Funds contributed by Twin City Rapid Transit Company of St. Paul, Minn., for construction of bridge over Mississippi River at Fort Snelling-----	4,128.43

*Estimates.*—The following estimates are submitted by the Chief of Engineers for the fiscal year ending June 30, 1909:

Under continuing contracts-----	\$25,142.744
Under California Débris Commission (expenses)-----	15,000
Prevention of deposits in New York Harbor-----	153,260
Enlargement of Governors Island, New York-----	75,000

In addition to the above the Mississippi River Commission submits an estimate amounting to \$3,000,000, reduced in this office to \$2,000,000.

*Engineer divisions.*—The engineering works in charge of this office are arranged in divisions, and officers of the Corps of Engineers were assigned as division engineers to overlook these works, as follows:

East of the Rocky Mountains: Northeast Division, Col. Amos Stickney to June 4, 1907, and Col. John G. D. Knight since that date; Eastern Division, Col. Amos Stickney to June 4, 1907, and Col. D. W. Lockwood since that date; Southeast Division, Lieut. Col. Dan C. Kingman; Gulf Division, Col. Clinton B. Sears to July 16, 1906, and Col. E. H. Ruffner since that date; Central Division, Col. G. J. Lydecker; Northwest Division, Lieut. Col. W. H. Bixby. West of the Rocky Mountains: Pacific Division, Col. W. H. Heuer to March 2, 1907, and Lieut. Col. John Biddle since June 12, 1907; Northern Pacific Division, Lieut. Col. S. W. Roessler, since June 3, 1907.

*Preliminary examinations and surveys.*—The river and harbor act of March 2, 1907, provides for preliminary examinations and surveys of certain localities, and the duty of making the same has been assigned to boards of engineers and to officers of the Corps of Engineers in charge of the various engineering districts. Reports thereon will be duly submitted when received.

#### IMPROVEMENT OF RIVERS AND HARBORS IN MAINE AND NEW HAMPSHIRE.

This district was in the charge of Lieut. Col. W. M. Black, Corps of Engineers, having under his immediate orders Capt. C. W. Otwell, Corps of Engineers, to October 12, 1906, and of Captain Otwell October 12, to November 24, 1906; in the temporary charge of First Lieut. H. C. Jewett, Corps of Engineers, November 24, 1906, to January 15, 1907, and of Maj. Edward Burr, Corps of Engineers, January 15 to May 18, 1907; and in the charge of Maj. George A. Zinn, Corps of Engineers, since May 18, 1907. Division engineer, Col. Amos Stickney, Corps of Engineers, to June 4, 1907, and Col. John G. D. Knight, Corps of Engineers, since that date.

1. *Lubec Channel, Maine.*—This channel lies between the eastern extremity of the State of Maine and Campobello Island, Canada.

Originally the depth was about 5 feet at mean low tide and 2 feet at low water of spring tides.

A project was adopted in 1879 which, as subsequently modified, provided for a channel 275 feet wide, increasing to 300 feet in the bends, and 12 feet deep at mean low tide. This project was completed in 1890, practically as proposed, at a cost of \$168,954.68.

The present project was adopted August 18, 1894, and its object was to widen the then existing channel to a least width of 500 feet, at an estimated cost of \$150,000. The amount expended on the work of the existing project up to the close of the fiscal year ending June 30, 1907, was \$138,478.30. At the latter date the channel had been dredged to the full projected width and depth contemplated by the project of 1894. The work will probably be reasonably permanent, but examinations will be made from time to time, when opportunity offers, to determine this question.

The maximum draft that can be carried is about 11.5 feet at mean low water; the mean variation in tide level is 18.2 feet. The channel, which is about 3 miles long, connects the roads above with the Atlantic Ocean, and is the convenient and direct approach to Lubec, Eastport, and St. Croix River from the westward. It is an international passage, and the benefits from the improvement are almost entirely general. As the tidal currents are very strong and dense fogs prevail a large part of the time, the widening of the passage decreases the chances of stranding and collision.

The commerce is reported as follows, in tons: 1898, 87,000; 1899, 126,700; 1900, 76,800; 1901, 165,000; 1902, 148,400; 1903, 127,000; 1904, 76,200; 1905, 86,000; 1906, 74,400.

For reports on examinations and surveys see page 279, Annual Report Chief of Engineers for 1879, and page 616, report for 1891.

The expenditures during the fiscal year include a proportion of the cost of maintenance of office of division engineer.

July 1, 1906, balance unexpended.....	\$11, 917. 02
June 30, 1907, amount expended during fiscal year.....	350. 00

July 1, 1907, balance unexpended.....	11, 567. 02
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(See Appendix A 1.)

2. *Narraguagus River, Maine.*—The navigable portion of the river is 7 miles in length. The town of Millbridge is located about 2 miles above its mouth and the lumber town of Cherryfield at the head of navigation. The mean range of tide is 11.3 feet.

Before improvement the river was obstructed from its mouth to Millbridge by a bar having a depth of 6 feet at mean low tide and less than 4 feet at extreme low tide. Between Millbridge and Cherryfield the river was obstructed by bowlders and ledge.

The original project upon which the first appropriation was made is set forth in the district officer's report of December 8, 1870, and provided only for the betterment of navigation above Millbridge by the removal of obstructions, such as mill waste, sunken bowlders, and the construction of an iron spindle on Half Tide rock. This work was completed in 1874. The amount expended was \$22,000, and the resulting improvement is said to have been of great benefit to navigation.

The improvement of the river below Millbridge was provided for by project submitted in 1880. Its object was to dredge a channel 200 feet wide and 11 feet deep as far up as Long Wharf, and 9 feet thence to the anchorage known as Deep Hole. The estimated cost was \$50,000, and appropriations aggregating this amount were made between 1886 and 1899.

The amount expended on the latter project to the end of the fiscal year 1907 was \$49,643.81; but the project was not completed as originally projected, a change having been made necessary by the abandonment of Long Wharf by the steamboat company and the erection of a new wharf farther down the river. This change of location of the steamboat wharf rendered unnecessary any further dredging above that point, and accordingly the last appropriation was expended in dredging in front of the wharf and between that point and the deep water of the bay. In obtaining a depth of 11 feet to the steamboat wharf where it is now located the main object of the improvement has been accomplished. The work is only temporary. The material excavated was a mixture of sawdust and mud, and will be replaced in the course of a few years by a new deposit of the same material. It is reported that the portion of the river in front of the wharf has already shoaled to a depth of 7 feet at mean low tide.

Nothing has been done during the fiscal year.

The commerce for the last eight years is given as follows, in tons: 1898, 26,147; 1899, 23,545; 1900, 35,825; 1901, 41,934; 1902, 32,885; 1903, 40,525; 1904, 41,925; 1905, 52,750; 1906, 37,760.

More than 50 per cent of the tonnage is lumber.

For reports on examinations and surveys see Annual Reports of Chief of Engineers, page 831, report for 1871, and page 535, report for 1881.

July 1, 1906, balance unexpended.....	\$356. 19
July 1, 1907, balance unexpended.....	356. 19

(See Appendix A 2.)

3. *Breakwater from Mount Desert to Porcupine Island, Bar Harbor, Me.*—The object of the breakwater is to protect the wharves of Bar Harbor and the anchorage in front of the town from the heavy seas of southerly gales.

The present project is the original one, approved June 14, 1889, modified as to length of breakwater by the revised project of 1893. It provides for a breakwater of riprap stone, extending from Porcupine Island, a distance of 2,500 feet in a westerly direction, to a point about 600 feet from the low-water line of Mount Desert Island, the estimated cost being \$420,200.

The expenditures to June 30, 1907, were \$189,789.18, by which date the breakwater had been raised to a height of mean high tide for a distance of 1,790 feet from Porcupine Island. The width on top is 20 feet and the side slopes are such as the rock naturally assumes. As funds become available the existing work will be maintained and extended until the proposed length is obtained, after which the cross section will be strengthened to the extent required for permanency.

The beneficial effects resulting from the portion of the breakwater already built in protecting the wharves at Bar Harbor and the anchorage basin are appreciably felt; but in order to secure the desired protection at high water of spring tides it will probably be found necessary to raise the breakwater to a height of about 6 feet above mean high tide. The mean range in tides is 11.5 feet.

The benefits to navigation are general in providing a harbor of refuge, and local in making it possible for boats to land at the wharves at all times with safety. The only convenient method of transportation to and from Bar Harbor is by boat.

No work has been done since 1900. At the last inspection it was noted that the crest of the portion in place had been lowered throughout about 6 feet by storm action.

The commerce has been reported as follows, in tons: 1898, 22,175; 1899, 24,393; 1901, 42,150.

For report on examination and survey see Annual Report of Chief of Engineers for 1887, page 481.

July 1, 1906, balance unexpended.....	\$210. 82
Amount appropriated by river and harbor act approved March 2, 1907.....	30, 000. 00

July 1, 1907, balance unexpended.....	30, 210. 82
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Amount (estimated) required for completion of existing project.....	200, 200. 00
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(See Appendix A 3.)

4. *Harbor at Sullivan Falls, Maine.*—Sullivan River has a length of about 6 miles and is the outlet of a large bay. About midway of its length a point of land projects to such extent as to reduce the width to about one-fourth that immediately above and below, and at this place the slope and velocity are such that the locality is termed "Sullivan Falls." The bottom is ledge, the higher portions forming dangerous obstructions to navigation. Hatchers rock, about midway of the narrow channel at the falls, had originally only about 6 inches of water over it at mean low tide. The mean range in tides is 11.5 feet.

Under a project set forth in report of the district engineer dated December 10, 1870, and under appropriations based thereon, the sum of \$35,000 was expended in removing three old piers, in excavating

the obstructing ledges at the falls to a depth of 7 feet at mean low tide, and in replacing spindles on two rocks near the mouth of the river. This work was completed in 1875 and was of material benefit to navigation.

The present project is that referred to in the river and harbor act of June 3, 1896, as the "approved project," and published in the Annual Report of the Chief of Engineers for 1891, page 619. It provides for removing Hatchers rock and two other points of ledge to a depth of 10 feet at mean low tide, at an estimated cost of \$35,000.

The expenditures under the existing project to June 30, 1907, were \$14,870.64, and the operations consisted in removing the entire area of Hatchers rock and about five-sixths of ledge "C" to a depth of 10 feet at mean low tide. About 70 per cent of the work covered by the project has been completed.

To complete the present project the remaining part of ledge "C," containing about 67 cubic yards in situ, and ledge "B," containing 255.3 cubic yards in situ, will have to be removed.

The improvement not only increases the navigable depth, but also, by removing the cause of eddies and cross currents, has added to the length of time at each high and low tide during which vessels may pass through the rapids with safety.

Vessels can not use the channel at low stages except when the tide is slack. This occurs after the tide has flowed about 2 feet, at which time vessels drawing 11 feet can pass through safely.

The improvement may be regarded as permanent.

The commerce for the last six years has been as follows, in tons: 1900, 35,926; 1901, 49,125; 1902, 37,050; 1903, 45,700; 1904, 31,400; 1905, 42,100; 1906, 29,450.

The commerce consists almost entirely of granite.

For reports on examinations and surveys, see Annual Report of Chief of Engineers, page 836, report for 1871; and page 619, report for 1891.

July 1, 1906, balance unexpended.....	\$204.36
June 30, 1907, amount expended during fiscal year, for works of improvement .....	75.00

July 1, 1907, balance unexpended.....	129.36
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Amount (estimated) required for completion of existing project.....	20,000.00
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(See Appendix A 4.)

5. *Union River, Maine.*—The navigable portion of the river extends from the head of Union Bay to the foot of the falls at Ellsworth, a distance of about  $3\frac{3}{4}$  miles.

Before improvement the channel was obstructed by a large deposit of slabs, edgings, and sawdust near Ellsworth, which practically suspended navigation except at high tide, by projecting ledges in the Narrows about three-fourths of a mile below the wharves at Ellsworth, by bowlders at several points along the channel, and by a broad, flat bar of sawdust and mud at the mouth.

The first project for the improvement of the river is contained in the report of the district officer dated June 30, 1867, and provided for erecting beacons, removing sunken ledges and bowlders, and dredging mill waste near Ellsworth, so as to secure a depth of 3 feet at mean low tide, this being the available depth on the bar at the mouth of the

river. This improvement was completed in 1873 with an expenditure of \$30,000.

A survey was made in 1889 under the provisions of the act of 1888, and a new project was submitted with a view to obtaining a depth of 6 feet at mean low tide from the wharves at Ellsworth to deep water in the bay. This depth was to be obtained by dredging mill waste near Ellsworth, by removal of ledge in the Narrows, and by dredging across the bar at the mouth of the river. To maintain the improved depth of the latter point the same project provided for the construction of a training wall to concentrate the ebb flow in the channel. The present authorized project is that described above with the training wall omitted, and is published on page 461, Part 1, Annual Report of the Chief of Engineers for 1890.

The act of June 3, 1896, appropriated \$15,000 for beginning the improvement. This sum was expended in excavating to a depth of about 6 feet over a section of river about 3,000 feet long in the vicinity of the Narrows, and in carrying a single cut of the dredge to the same depth as far up as the wharves, to afford immediate relief to navigation. This single cut was partly filled with new deposit by the next freshet.

By the act of March 3, 1899, the sum of \$15,000 was appropriated and a contract was authorized for completing the improvement, at an additional cost of \$115,000.

Changes having occurred since the making of the survey upon which the project was based, a new survey was made in May, 1899, and a project for securing the completion of the improvement, with such changes in quantities as were shown to be necessary by the survey, was approved by the Secretary of War June 28, 1899.

This project was completed in 1902. The dredging at the mouth of the river and the removal of the ledge in the Narrows were accomplished, and the channel at Ellsworth, where the material was saw-mill waste, was dredged, but the depth at the latter place is not expected to maintain because of the movement during freshets of material from the great deposits of mill waste at that locality.

The expenditures to June 30, 1907, in connection with the last project were \$142,101.36.

The mean range in tide is 11.5 feet.

The commerce for 1906 is given as 15,759 tons, with an estimated valuation of about \$80,000. The business by water is reported to be decreasing and that by rail increasing.

For reports on examinations and surveys, see Annual Reports of Chief of Engineers for 1867, page 501; 1890, page 458; 1897, page 800; 1898, page 839, and 1899, page 1026.

July 1, 1906, balance unexpended.....	\$2,898.64
July 1, 1907, balance unexpended.....	2,898.64

(See Appendix A 5.)

6. *Bagaduce River, Maine.*—This is a small stream that empties into Penobscot Bay at Castine, Me. The upper part of the river divides into two branches, one called Northern Bay and the other South Bay. Northern Bay, near South Penobscot, is a shoal sheet of water of about 700 acres area, the bottom of which for the greater part is bare at low tide. Before improvement there was a narrow channel from Bridges Point to Bowden's wharf, which had a depth



of less than 2 feet and was obstructed by ledges and boulders near Winslows Island. The South Bay is obstructed by ledges at Johnsons Narrows. Mean rise and fall of tide, 9.8 feet.

The approved project is understood to be that published at page 398 of the Annual Report of the Chief of Engineers for 1888. Its object is to secure a channel 100 feet wide and 6 feet deep at mean low tide from Bridges Point, Northern Bay, to Bowden's wharf, at an estimated cost of \$45,000. The same project provides for removing a small quantity of rock in the channel at Johnsons Narrows, at an estimated cost of \$1,875. All work done has been in accordance with this project. About one-third of the work covered by the project may be said to have been completed.

The expenditures to June 30, 1907, were \$28,000. At that date there had been made, by dredging and the removal of rocks and boulders, a channel 40 feet wide and 6 feet deep at mean low tide, except at Winslows Island, where a depth of only 4 feet has been secured. The total length of channel is about 4,000 feet.

The improvement has been regarded as of doubtful public value, and it is only recently that any use has apparently been made of the dredged channel. A small power boat now makes regular trips from Castine, carrying passengers and freight.

For reports on examinations and surveys, see Annual Reports of the Chief of Engineers for 1888, page 398; 1893, page 724, and 1898, page 842.

The tonnage for 1906 is given as 105,990 tons, but this includes the business of Castine, at the mouth of the river. The commerce of the Bagaduce proper is put at about 27,000 tons, with an estimated value of about \$175,000.

July 1, 1906, balance unexpended.....	\$51.10
June 30, 1907, amount expended during fiscal year, for works of improvement.....	51.10

Amount (estimated) required for completion of existing project....	18,875.00
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(See Appendix A 6.)

7. *Penobscot River, Maine.*—Except the dredging of a sawdust bar opposite High Head, near Bucksport, Me., the improvements have been confined to a stretch of about  $3\frac{1}{2}$  miles of the river at and below Bangor. Before improvement this part of the river was obstructed by ledge, boulders, and mill waste to such extent as to afford a safe available depth of only about 6 feet at extreme low tide. The mean range in tides is 13.1 feet.

The head of navigation is at Bangor; from thence to the head of the bay is about 27 miles.

The first project was approved August 22, 1870, and called for a depth of 12 feet at lowest tides for a width of 150 feet over  $3\frac{1}{2}$  miles of river at and below Bangor. There was expended \$198,300.

After a survey, ordered by the act of September 19, 1890, the project was modified and extended to include a depth of 11 feet at extreme low tide for a width of 360 feet in Bangor Harbor; to widen, straighten, and deepen the channel near Crosbys Narrows and Sterns's mill to a depth of 12 feet at extreme low tide, and to secure a depth of 22 feet at mean low tide between Bucksport and Winterport, at an estimated cost of \$440,000. March 3, 1899, the project was again extended by providing for removal of ledge in front of the Boston

and Bangor Steamboat Company's wharf at Bangor and for deepening the basin of Kenduskeag stream at its junction with the Penobscot, and \$28,000 was appropriated for the work. The results contemplated under these appropriations are regarded as practically accomplished.

By the act of March 2, 1907, Congress adopted a further project for an additional width at Bangor, varying from 100 to 300 feet for a length of nearly 2,000 feet, the depth to be 11 feet at extreme low tide (14 feet at mean low water). The estimated cost of this work is \$130,000.

The expenditures under the modified and enlarged project (since 1890) have been \$169,500, and the object of the projects has been virtually secured down to that of March 2, 1907, though all the work estimated for has not been carried out.

The available depths are as follows: Bangor Harbor, 14 feet at mean low tide or 11 feet at extreme low tide; at Sterns's mill and Crosbys Narrows, 15 feet at mean low tide or 12 feet at extreme low tide. The shoal at Frankfort flats was dredged to 22 feet at mean low tide and, so far as known, has given no trouble since. At High Head, above Bucksport, the material is soft and shifting; no permanent good can be accomplished by dredging, and, as the shoal is not dangerous, no further work is recommended.

No work was done during the fiscal year 1907. The project for widening the channel at Bangor, adopted in 1907, is to satisfy a demand for an increase in harbor capacity.

For list of examinations and reports see Annual Report of Chief of Engineers for 1906, page 25. The existing project for additional width at Bangor is printed in House Document No. 739, Fifty-ninth Congress, first session.

The tonnage for 1905 was given as 848,872, of which about 430,000 was coal, and about 254,000 tons lumber and wood. A conservative estimate of the value of the commodities is \$3,286,428.20.

#### GENERAL IMPROVEMENT.

July 1, 1906, balance unexpended.....	\$8,565.73
June 30, 1907, amount expended during fiscal year, for works of improvement.....	65.73
July 1, 1907, balance unexpended.....	8,500.00

#### AT BANGOR.

Amount appropriated by river and harbor act approved March 2, 1907.....	\$130,000.00
July 1, 1907, balance unexpended.....	130,000.00

(See Appendix A 7.)

8. *Bucksport Harbor, Me.*—The mean range in tide is 10.6 feet. Before improvement the bed of the river on the east side in front of the wharves of Bucksport was obstructed by a deposit of sawdust and mud, having a minimum depth of about 4 feet at mean low tide.

Under appropriations aggregating \$16,500, this obstructing shoal, locally known as the Middle Ground, was dredged between 1875 and 1878, under the general project for improving Penobscot River, to a depth of 12 feet at mean low tide over that portion of its area lying

immediately in front of the wharves, and to a depth of 8 feet over the remainder.

The existing project is based upon a report of a survey printed in the Annual Report of the Chief of Engineers for 1900, page 1103, and was adopted by the act of June 13, 1902. It provides for removing the Middle Ground, which had again shoaled, to a depth of 16 feet at mean low tide, at an estimated cost of \$20,000.

The expenditures under existing project to close of fiscal year ending June 30, 1907, have been \$18,700. The improvement was completed in 1903.

As there are large sawdust and mud bars above this point, which are set in motion in times of freshet, it is expected that the area dredged at Bucksport will slowly fill in again in the course of years. The improvement should therefore not be regarded as entirely permanent.

The commerce for 1906 is given as 15,572 tons, the largest items being coal and ice. The estimated value of the commerce is \$90,872.

July 1, 1906, balance unexpended.....	\$1,404.01
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	104.01

July 1, 1907, balance unexpended.....	1,300.00
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(See Appendix A 8.)

9. *Camden Harbor, Me.*—The mean range in tide is 9.7 feet. Before improvement navigation was impeded by shoal water, there being a depth of about 6 feet in the outer harbor at the steamboat landing and less than 1 foot in the inner harbor, where most of the wharves are located.

The first project is contained in the district officer's report of December 17, 1872, and provided for dredging two channels, one 1,500 feet long, 100 feet wide, and 7 feet deep at mean low water on the easterly side of the harbor, the other 1,400 feet long, 100 feet wide, and 7 feet deep at mean low water. This improvement was completed in 1875, under appropriations aggregating \$30,000 made by acts of 1873, 1874, and 1875.

The harbor was again surveyed and a new project submitted in 1887, under the provisions of the river and harbor act of 1886. This project provided for dredging at the entrance to the harbor to a depth of 12 feet at mean low tide; to dredging a channel on each side of the harbor and approaches to the same to a depth of 10 feet; to dredging small channels along the wharves at the extreme upper end of the harbor to 5 feet, and, after completion of the above, to dredging the Middle Ground of the harbor to the same depths as the adjacent channels. The project was completed in 1897, with an expenditure of \$44,940.79.

There is one small stream emptying into the harbor at the extreme upper end, but it is not a silt-bearing stream, and it is believed that the improved depths have remained practically permanent.

Under the provisions of the river and harbor act of March 3, 1899, a new survey was made in the vicinity of the Boston and Bangor Steamboat Company's wharf in the outer harbor and a project submitted for increasing the depths in this vicinity to 14 feet at mean and 11 feet at extreme low water so as to accommodate the boats of this line, which have had difficulty in reaching their wharves at

extreme low run of tides. The cost was estimated at \$7,400. This project is published at page 1111 of the Annual Report of the Chief of Engineers for 1900. The work covered by the project has been completed.

Expenditures under the latter project up to June 30, 1907, were \$7,459.21, and resulted in completion of the improvement, giving a uniform depth of 14 feet at mean low tide over an area in front of the Eastern Steamship wharf, where the depth had previously ranged from 9.5 to 13 feet.

For reports on examinations and surveys see Annual Reports of Chief of Engineers for 1873, page 1106; 1888, page 403, and 1900, page 1111.

The tonnage for 1906 is given as 37,848 tons, of which 16,350 tons was coal, 6,000 tons lumber, and 1,200 tons wool.

A conservative estimate of the value is \$817,830. It is impracticable to state specifically what the effect of the project on freight rates has been, but it has permitted of keeping open water routes of transportation by heavier vessels, which otherwise might have been impracticable.

July 1, 1906, balance unexpended.....	\$103.28
June 30, 1907, amount expended during fiscal year, for maintenance of improvement .....	103.28

(See Appendix A 9.)

*10. Rockland Harbor, Maine.*—The wharves are located on the shores of three coves, formed by two projecting points of land on the western side of the harbor, known as Crocketts Point and Atlantic Point. The general direction of the wharf frontage is north and south, and the length of frontage is about 800 feet. Before improvement depths in front of the wharves increased very slowly. All the wharves except those at the end of Crocketts Point and Atlantic Point extended only a short distance beyond the low-water contour, a high mean range in tide, which at this point is 9.6 feet, being relied upon to give access to moderate and light draft vessels at high tides. The entrance to the harbor from the east has a width of about 9,000 feet.

Before improvement the anchorage in front of the wharves, vessels lying at the wharves, and the wharves themselves were endangered by heavy seas during easterly gales.

The first improvement undertaken was to render it a safe harbor of refuge for coastwise shipping, and incidentally also to protect the wharves as far as possible from heavy seas. To accomplish this a project was adopted in 1881 in which two breakwaters were contemplated, one extending south from Jamesons Point, the other a detached breakwater nearer to and opposite the principal wharves in the town; both to be raised in the first instance to the level of mean tide, but with the expectation that a further raising would be necessary as experience might dictate.

In 1886 this project was amended so as to raise the height of the breakwater at Jamesons Point to the level of mean high tide. In 1890 it was again amended so as to eliminate the detached breakwater and to provide for extending farther south than was first contemplated the breakwater at Jamesons Point.

By the act of June 3, 1896, Congress adopted a project for dredging the inner harbor in the vicinity of the wharves to depths ranging

from 4 feet to 13 feet at mean low tide and for removing two dangerous ledges, one occupying a central position in the harbor, which was to be cut down to the depth of 22 feet at mean low tide; the other, less centrally located, was to be removed to a depth of 14 feet. The estimated cost was \$403,000. By the same act this project was combined with that for the breakwater as one project, and authority was given for completing the whole under the continuous-contract system, at an estimated expenditure of \$1,036,000.

The dredging was finished in May, 1901; the removal of ledge in the fall of 1901. The breakwater was also completed to the height and slopes contemplated before the close of the same season. The sea slope of the breakwater did not maintain its status under the heavy winter gales and ice, and during the succeeding four years 52,372 tons of heavy riprap was placed on it. This was for improvement rather than maintenance, as it was to be expected that some work would be necessary from time to time until the slopes assumed a state of rest.

The total expenditures to the close of the fiscal year 1907 were \$920,025.79. The benefits resulting are that the breakwater affords a safe and extensive anchorage and harbor of refuge. The removal of ledges has increased the available anchorage area, and the dredging affords access to the wharves by vessels of greater draft.

The project is regarded as completed, subject to any work that may be needed from time to time until the slopes of the breakwater have assumed a condition of permanence.

The expenditures during the fiscal year 1907 were chiefly for office expenses.

For reports on examinations and surveys see Annual Report of Chief of Engineers for 1893, page 729, and report for 1896, page 581.

The business for 1906 was 591,250 tons, of which 110,000 tons was coal and 250,000 tons lime.

It is impracticable to state definitely the value of the commerce, but it has been estimated at \$3,385,300.

The direct effect on freight rates can not be definitely stated, but the improvement has provided a commodious harbor of refuge, in addition to keeping pace with the local demand for better facilities.

July 1, 1906, balance unexpended.....	\$5, 324. 08
June 30, 1907, amount expended during fiscal year.....	349. 87

July 1, 1907, balance unexpended.....	5, 474. 21
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(See Appendix A 10.)

11. *Carvers Harbor, Vinalhaven, Me.*—The object of the improvement is to secure a better anchorage than the harbor afforded in its natural state. Before improvement the anchorage was limited as to area and depth, there being less than 8 feet at mean low tide over the most of it.

The project of improvement, as approved by the Secretary of War May 11, 1897, provides for dredging the inner harbor to a depth of 16 feet at mean low tide over an area about 23 acres in extent and at an estimated cost of \$64,000.

The expenditures under the existing project up to the close of the fiscal year ending June 30, 1907, amounted to \$43,199.70.

The project is completed, giving 16 feet at mean low tide over an area about 1,300 feet by 750 feet, or practically all that part of the inner harbor used for commerce.

The improvement will be fairly permanent and will be a benefit to navigation in affording a harbor of refuge and increased facilities for reaching the wharf.

The mean range in tides is 9.3 feet.

For reports on examination and survey see Annual Reports of Chief of Engineers for 1893, page 725, and for 1895, page 587.

The expenditures during fiscal year 1907 were for office expenses.

The commerce for 1906 is given as 72,886 tons, nearly 43,000 tons of which was stone.

July 1, 1906, balance unexpended.....	\$1, 913. 40
June 30, 1907, amount expended during fiscal year.....	113. 10

July 1, 1907, balance unexpended.....	1, 800. 30
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(See Appendix A 11.)

12. *Georges River, Maine.*—This river is a tidal estuary with a mean rise and fall of the tide of 10 feet. The head of navigation is Thomaston, Me.

The navigable depth is full  $3\frac{1}{2}$  fathoms to a point about 1 mile from Thomaston, but from this point to the head of navigation the channel before improvement was narrow, with a short bend at one point and with a least depth of about 11 feet at mean low tide.

By act of June 3, 1896, Congress adopted a project for dredging to 16 feet at mean low tide, and to widths as follows: As far up as the bend, 160 feet; in the bend, 220 feet; beyond the bend, 125 feet, narrowing to 90 feet at the upper end.

The estimated cost was \$26,000.

The expenditures to June 30, 1907, were \$26,000, and the work covered by the project has been accomplished.

Gradual shoaling by material brought down by freshets may be expected, but the process will be slow and a depth sufficient to accommodate the traffic will probably be maintained for a number of years.

The depth of the dredged channel is such that vessels could be towed out at any stage of the tide, but as the business at that locality does not seem to warrant the maintenance of a tug they have to wait until near high water and a favorable wind in order to go in or out under sail with safety.

The total amount charged to maintenance is \$212.09, of which \$142.09 was expended during the year 1907 for office expenses.

For report on examination and survey see Annual Reports of Chief of Engineers for 1893, page 734, and for 1895, page 591.

The commerce for 1906 was 18,950 tons, principally coal, lime, and wood. A conservative estimate of the value would be \$85,600.

July 1, 1906, balance unexpended.....	\$142. 09
June 30, 1907, amount expended during fiscal year.....	142. 09

(See Appendix A 12.)

13. *Sasanoa River, Maine.*—Originally this stream was much obstructed in the vicinity of Upper Hell Gate. The channel at and near that place was crooked and narrow, and was obstructed by

dangerous ledges, the shoalest of which had not more than 3 feet of water over it at mean low tide.

Between 1870 and 1881 the sum of \$45,500 was appropriated, and the navigation was much improved by rock excavation, dredging, and the construction of a small jetty.

By act of June 3, 1896, a new project was adopted for widening the channel at Upper Hell Gate to 125 feet, with a depth of 12 feet at mean low tide, by ledge excavation; for dredging to the same depth at Carletons ledges, and for constructing a small jetty at the Camp Ground, at an estimated cost of \$19,000, which amount was appropriated by the same act. This project was completed in 1898 at a cost of \$11,987.69.

The present project submitted by the Board of Engineers for Rivers and Harbors, February 7, 1907, is to increase to a width of not less than 140 feet the channel 90 feet wide made under the first project through the ledges southeastwardly of Upper Hell Gate, and to remove Flat rock, all to the depth of 12 feet at mean low tide. This project was adopted by the act of March 2, 1907, which contained an appropriation of the entire estimated cost, viz, \$44,000.

The expenditures under the existing project to June 30, 1907, have been \$458.05. No actual work has yet been done. Specifications for doing all the work covered by the project have been printed and issued, and bids invited by public advertisement.

The Sasanoa is a tidal river or thoroughfare about 9 miles in length, connecting the Kennebec River at Bath, Me., with Sheepscot River. It is navigable throughout its entire length, and has about 12 feet depth at mean low tide over the shoalest parts. The mean range of tide in the vicinity of the proposed improvement is about 8.5 feet. The exact tonnage for 1906 is not known, but the value is estimated as over \$125,000. The number of passengers carried exceeded 70,000. The effect on freight rates can not be stated in a definite way, but the improvement permits the use of larger vessels necessary to accommodate the increasing business and renders the passage less dangerous.

For reports on examinations and surveys see Annual Reports of the Chief of Engineers for 1867, page 499; 1895, page 593; for map 1880, page 334.

Amount appropriated by river and harbor act approved March 2, 1907 .....	\$44,000.00
June 30, 1907, amount expended during fiscal year, for works of improvement .....	458.05
July 1, 1907, balance unexpended .....	43,541.95
July 1, 1907, outstanding liabilities .....	50.00
July 1, 1907, balance available .....	43,491.95

(See Appendix A 13.)

14. *Kennebec River, Maine.*—Before improvement the main channel of the river between the foot of Swan Island and Gardiner was obstructed by shoals near Beef rock, with only 10 feet of water at mean low tide, by dangerous sunken ledges in Lovejoy Narrows, by a shoal below South Gardiner, with only 8 feet on it at mean low tide, and by a ledge at Nehumkeg Island. The steamboat channel to the west of Swan Island (at Hatchs rock) was obstructed by a shoal over which there was only  $7\frac{1}{2}$  feet of water, and the channel between

Gardiner and Augusta, a distance of  $6\frac{1}{2}$  miles, was obstructed by shoals which gave a navigable depth of only  $3\frac{1}{2}$  feet in low summer tides.

Appropriations for minor improvements were made at various times between 1827 and 1852.

In 1866 a project was begun for improving the upper part of the river, with a view to obtaining a channel 7 feet deep and 100 feet wide at low water. This project, with modifications, was completed in 1877, and resulted in obtaining a channel 10 feet deep at mean low tide and not less than 100 feet wide in its lowest summer stages as far up as Gardiner, and a depth of  $6\frac{1}{2}$  feet at low tide and width of 100 feet from Gardiner to Augusta.

The channel west of Swan Island, being obstructed by shoal water ( $8\frac{1}{2}$  feet at mean low tide) and a too narrow channel at the head of the island, by shoal water at Hatchs rock, below Richmond, and by a very narrow channel 30 feet wide at the foot of the island, was improved by dredging in 1881–1883, so as to give a channel 175 feet wide and 11 feet deep at the foot of the island and a channel of about 80 feet width and 10 feet depth at Hatchs rock and the head of the island.

The river and harbor act of 1886 provided for a new survey of the river from Bath to Augusta. This survey was made in 1887, and a project embracing dredging, rock excavation, and contraction works was submitted for the further improvement of the river. In 1892 this project was revised to secure depths as follows: Thirteen feet at mean low tide as far up as Sands Island, 12 feet thence to Hinckleys shoal, above Gardiner, and 10 feet thence to Augusta, at an estimated cost of \$388,500. This project was approved August 19, 1892, and was essentially completed in 1898.

The total expenditures upon the river to June 30, 1907, under the projects above enumerated, were \$487,850.

The improved channel obtained under the above projects has suffered some loss of available depth by the deposits brought down by freshets. This shoaling has been most marked in the stretch of  $6\frac{1}{2}$  miles of river between Gardiner and Augusta, the further improvement of which is provided for by the river and harbor act approved June 13, 1902, which appropriated \$40,000 and authorized a continuous contract for the completion of the project. The last project is published at page 1121 of the Annual Report of the Chief of Engineers for 1900, and proposes a widening of the channel from Gardiner to Augusta to 125 feet and a cleaning out of the old dredged channel and its further deepening to 16 feet at mean high water, or 11 feet at mean low water.

The expenditures under the project of 1902 have been \$18,089.35. A contract for all the work between Gardiner and Augusta has been made with the Eastern Dredging Company, and work was commenced June 7, 1906, suspended for the winter November 7, 1906, and resumed June 19, 1907. Up to the end of the fiscal year about 55,000 cubic yards of material had been removed, or about 25 per cent of the whole number of cubic yards estimated to complete the contract. The total estimated amount (\$81,000) to complete the project has been appropriated and is now available. It is proposed to continue work under this contract until the project is completed.

A project for improvement between the mouth and Gardiner was adopted by the river and harbor act of March 2, 1907, and is de-



signed to obtain, by dredging and ledge excavation, channels through the shoals between the foot of Swan Island and Gardiner at least 150 feet wide and of such depths that for a vessel passing up the river at the usual speed on the flood tide and timed to reach Gardiner at high water the available depth would at no point be less than 20.5 feet. The depth over ledge is to be 1 foot greater than this. Two training walls are to be repaired and one of them lengthened 700 feet. The cost of the project is estimated at \$275,000.

The sum of \$75,000 was appropriated, with authority to make contracts to complete the project at a cost not to exceed \$200,000 additional, which is yet to be appropriated. Specifications for contracts for the work under this project are now being prepared. Expenditures under this project have been \$3.71.

It is proposed to apply the new appropriation asked for to continuing the improvement of the river from the mouth to Gardiner.

The mean rise and fall of tides at Bath is 6.9 feet; at Gardiner 5.1 feet; at Augusta 4.3 feet. Augusta is the head of navigation and is about 44 miles above the mouth of the river. Probably not more than 7 feet at mean low tide could be carried up from Gardiner to Augusta, which is the shoalest part of the stream.

For reports on examinations and surveys see Annual Reports of the Chief of Engineers for 1867, page 488; 1881, page 479; 1888, page 412; 1892, page 541, and 1900, page 1121, and House Document No. 321, Fifty-ninth Congress, second session.

The commerce for 1906 amounted to 997,548 tons, the value of which has been conservatively estimated as \$4,849,550.

While the use of the river for transportation purposes has some value in a competitive way, the principal effect on freight rates is due to the increased depths, permitting the use of larger vessels for handling such commodities as coal, ice, and lumber, which demand cheap transportation. It was estimated by the American Ice Company in 1906 that an increase of 3 feet in depth (from 17 feet to 20 feet) would result in a saving of 20 cents per ton in the freight rate on ice. As the ice shipments for 1906 are placed at 500,000 tons, this would have amounted to \$100,000 for that year alone.

#### GENERAL IMPROVEMENT.

July 1, 1906, balance unexpended.....	\$12,666.38
June 30, 1907, amount expended during fiscal year, for works of improvement .....	166.38
July 1, 1907, balance unexpended.....	12,500.00

#### BETWEEN GARDINER AND AUGUSTA.

July 1, 1906, balance unexpended.....	\$54,802.75
Amount appropriated by sundry civil act approved March 4, 1907....	26,000.00
	80,802.75
June 30, 1907, amount expended during fiscal year, for works of improvement .....	17,892.10
July 1, 1907, balance unexpended.....	62,910.65
July 1, 1907, outstanding liabilities.....	4,898.81
July 1, 1907, balance available.....	58,011.84
July 1, 1907, amount covered by uncompleted contracts.....	56,579.58

## FROM THE MOUTH TO GARDINER.

Amount appropriated by river and harbor act approved March 2, 1907	\$75,000.00
June 30, 1907, amount expended during fiscal year, for works of improvement	3.71
July 1, 1907, balance unexpended	74,996.29
July 1, 1907, outstanding liabilities	209.60
July 1, 1907, balance available	74,786.69
Amount (estimated) required for completion of existing project	200,000.00
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{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907	100,000.00
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

(See Appendix A 14.)

15. *Portland Harbor, Maine.*—The entrance to the main part of the harbor of Portland, or the anchorage, has always been good, but before improvement the approach to the inner harbor was obstructed by a shoal known as the Middle Ground, over which the depth was only from 8 to 10 feet at mean low tide, while between it and Stamford ledge the greatest available depth was only 16 feet. The best part of the wharf front was exposed to swell from the main entrance, which sometimes made it dangerous for vessels to lie at the docks, and along this front the depth was in some places as shallow as 4 feet.

The first work of improvement undertaken by the Government was the construction of the breakwater. This was begun as early as 1836. It was completed in 1874.

The work of deepening the harbor was begun under the act of Congress of 1868, the plan of improvement being to excavate a channel 300 feet wide and 20 feet deep at mean low tide through the southern slope of the Middle Ground and to remove the bar off the Grand Trunk Railroad wharves to the same depth.

The project was modified in 1870 so as to provide for a channel 400 feet wide, and again in 1871 so as to provide for a channel 500 feet wide. In 1872 further modifications were made by including in the project the dredging of Back Cove and the dredging of the inner harbor up to the harbor commissioner's lines to a depth of 16 feet at mean low tide. The project, modified as above described, excepting some dredging in the inner harbor, was completed by 1876. Between 1881 and 1885 the Middle Ground was removed to a depth of 21 feet at mean low tide.

A further deepening of a portion of the harbor to 29 feet at mean low tide was next begun under the project of 1886. To this was subsequently added, in 1890, a small amount of dredging in the upper part of the harbor.

In 1894 the project was extended to cover the widening of the upper part of the 29-foot area and the dredging of a channel 25 feet deep to connect the deep water in the lower part of the harbor with deep water in the upper part. This work was completed in 1894.

By the act of June 3, 1896, Congress adopted a project for dredging to 30 feet at mean low tide over the greater part of the harbor, at an estimated cost of \$770,000, and included in the project the further improvement of Back Cove at a combined estimate of \$946,250. The

same act appropriated \$20,000 for beginning work, and authorized the making of a contract for its completion.

The latter project was completed in 1902, at a cost which was about \$253,000 less than the estimate. By the sundry civil act of March 3, 1905, Congress authorized an amendment to the project by which the 30-foot channel is to be continued up Fore River as far as the Boston and Maine Railroad bridge, a channel of entrance to Back Cove dredged to the same depth, the width in each case to be about 300 feet, and a small area on the south side of the harbor, in front of the old dry dock, also to be dredged.

The total expenditures up to the close of the fiscal year ending June 30, 1907, have been \$1,392,443.70—\$576,477.05 under former projects and \$815,966.65 under the existing one. As above stated, the various projects have been completed excepting the amendment of 1905, under which work was commenced the last day of October, 1905, and on which dredging has since been in progress.

The channel in Fore River between Boston and Maine bridge, Eastern Division, and Vaughan bridge, and the approach to the Eastern Division bridge have, in general, been dredged to full width and depth except about half way between the bridges, where an area of hard material was encountered which will require the use of a hard digging dredge.

The approach to Vaughan bridge and the channel between Vaughan bridge and the Boston and Maine Railroad bridge, Western Division, have not been dredged.

The channel at the entrance to Back Cove to be 30 feet deep at mean low water, and 300 feet wide in the reaches, and widened at the bends, is nearly completed, a strip 100 feet wide and about 1,500 feet long in the entrance reach, and a small shoal of hard material in the inner reach only remain to be done to complete the entrance channel. The area in front of the old dry dock is about 82 per cent completed.

There are no silt-bearing streams emptying into Portland Harbor, and the improved depths obtained under the project will be practically permanent. The maximum draft that can be carried to the wharves in Portland Harbor at mean low tide is 30 feet and to the wharves in Back Cove about 11 feet. The mean range in tide is 8.8 feet.

Two principal advantages have followed this large improvement. A large and well-sheltered deep-water anchorage has been created under the shelter of the breakwater, and the trans-Atlantic vessels can arrive and depart from their docks at the lowest stages of tide.

The portion of the harbor in which most of the dredging has been done is the lower part of so-called Fore River. This river is crossed by four bridges. Going up the harbor these are: (1) Portland bridge; (2) bridge of the Boston and Maine Railroad, Eastern Division; (3) Vaughan bridge, belonging to city; (4) bridge of Boston and Maine Railroad, Western Division. Portland bridge has a draw 65 feet wide, and admits vessels of the largest class coming to Portland. The next bridge has recently been reconstructed with a draw opening of 60 feet, and the city of Portland is now engaged in the reconstruction of the third bridge with an opening of not less than 60 feet. The improvement in the bridges and the new channels will afford great relief to the coal trade and other deep-draft commerce,

which has been much hampered and retarded by lack of room and sufficient water.

For reports on examinations and surveys, see Annual Reports of Chief of Engineers for 1886, page 541; 1893, page 735; 1901, page 1009, and House Document 445, Fifty-ninth Congress, first session.

The commerce for 1906 is given as 2,546,625 tons, of which about one-half was coal.

It is impracticable to make a definite statement as to the effect of the improvement on freight rates, but a large trans-Atlantic business has been greatly helped, and the capacity of the harbor has kept pace with the increase in size and draft of vessels used in the coal traffic with the accompanying saving in cost of transportation.

July 1, 1906, balance unexpended.....	\$140, 148. 16
Amount appropriated by sundry civil act approved March 4, 1907--	59, 000. 00

199, 148. 16

June 30, 1907, amount expended during fiscal year, for works of improvement.....	68, 864. 81
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July 1, 1907, balance unexpended.....	130, 283. 35
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July 1, 1907, outstanding liabilities.....	25, 581. 43
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July 1, 1907, balance available.....	104, 701. 92
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July 1, 1907, amount covered by uncompleted contracts.....	78, 219. 86
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(See Appendix A 15.)

16. *Saco River, Maine.*—In its original condition Saco River had a very winding course with abrupt bends and narrows, which, with its sunken rocks and ledges, presented many difficulties of navigation. The depth on the bar was only 2 feet at mean low water.

The original projects appear to have been—

(1) From 1824–1827 for the erection of piers, placing beacons and buoys, and removing obstructions near the entrance to the harbor. Under this project 12 piers of timber and stone were built, 10 in the river to mark sunken rocks and to facilitate navigation by sailing vessels, and 2 outside the mouth designed, but without success, to create a channel through the bar. The construction and maintenance of these works cost, 1824–1827, \$12,000.

(2) Adopted by the act of June 23, 1866, to construct a breakwater 2,915 feet long connecting the two outside piers, and to repair the river piers and improve the channel. Under this project, completed in 1874, the channel in the river and through the bar was improved, and a breakwater built on the north side of the channel 4,200 feet long and 10 feet high above mean low water, at an expense of \$162,271.75.

The existing project is the consolidation by the act of September 19, 1890, of the project adopted in 1884 for repairing the breakwater, extending it 2,200 feet to Sharps ledge, building a stone jetty on the south side of the channel, and dredging between the jetties, at an estimated cost of \$356,500; and the project adopted in 1886 for improving the river to Saco, 5 miles above its mouth, to the depth of 6 feet at mean low water, estimated to cost \$50,000, amounting to \$406,500. But some uncertainty seems to exist whether Congress has adopted that part of the project extending the breakwater 2,200 feet to Sharps ledge. By the report of the district officer in 1900, from an examina-

tion made at that time, it appears that extension of the breakwater is necessary to prevent the influx of sand into the channel, which is from the north side. The entire existing project or only 43 per cent of the same has been accomplished, depending upon whether or not the project be taken to include the extension of the breakwater 2,200 feet to Sharps ledge.

On June 30, 1907, there had been expended on this consolidated project \$172,258.37, with which all the works of improvement have been completed except the extension of the breakwater 2,200 feet to Sharps ledge, estimated to cost \$200,000, and upon which no work has been done. An examination made in 1900 showed that 3½ feet at mean low water was the maximum draft that could then be carried over the bar, the shoalest part of the locality under improvement. No examination has since been made from which the depth can be given to June 30, 1907.

The mean range of tides is 8.8 feet.

The head of navigation is at Saco and Biddeford on opposite sides of the river, to which towns, about 5 miles above the bar, the river is navigable in fact.

The commerce benefited by the improvement consists of coal and building materials, principally coal, and amounted, for 1906, to 40,679 tons, of an estimated value of \$206,735.

A description of the harbor and of the earliest improvements is published in the Report of the Chief of Engineers for 1866, page 188. The present project for improvement at the river's mouth is published in the report for 1884, page 484, and for improving the river above the bar in the report for 1886, page 552.

It is proposed to apply the available balance to extending the breakwater toward Sharps ledge.

July 1, 1906, balance unexpended.....	\$5, 241. 63
July 1, 1907, balance unexpended.....	5, 241. 63

Amount (estimated) required for completion of existing project.....	200, 000. 00
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(See Appendix A 16.)

17. *Cape Porpoise Harbor, Maine.*—Originally the harbor had a depth of about 13 feet at mean low tide, but for a small area only, and the entrance was obstructed by a bar on which there was only about 10 feet of water at mean low tide. The anchorage was too small to accommodate the craft seeking the harbor for refuge only, aside from the local commerce.

Under a project adopted March 3, 1899, a channel of entrance 200 feet wide and 16 feet deep at mean low tide and an anchorage area about 3,000 feet long, 600 feet wide, and 15 feet deep at mean low tide were secured by the close of the fiscal year 1902, under an outlay of \$72,501.15.

The present project, adopted by the act of March 2, 1907, aims to deepen and straighten the outer entrance channel, which is narrow and crooked, so as to give a width of 200 feet and a depth of 18 feet at mean low tide. The estimated cost is \$46,000, and the full amount was appropriated by the act of 1907.

The amount expended on the project of 1907 to the close of the year is \$74.20.

The mean range of tides is about 8.8 feet.

No commercial statistics have been obtained.

For reports on examinations and surveys see Annual Reports of the Chief of Engineers for 1895, page 583; for 1899, page 1050, and House Document No. 191, Fifty-ninth Congress, first session.

July 1, 1906, balance unexpended.....	<sup>a</sup> \$7, 498. 85
Amount appropriated by river and harbor act approved March 2, 1907.....	46, 000. 00
June 30, 1907, amount expended during fiscal year, for works of improvement.....	74. 20
July 1, 1907, balance unexpended.....	45, 925. 80
July 1, 1907, outstanding liabilities.....	1. 70
July 1, 1907, balance available.....	45, 924. 10

(See Appendix A 17.)

• 18. *Kennebunk River, Maine.*—By an act of Congress in 1798 provision was made for keeping in repair a pier built at the mouth of the river, and under subsequent projects, from 1829 to 1871, an easterly and westerly pier of stone at the mouth of the river, and a wharf of timber cribs filled with stone about 700 feet above the shore end of the easterly pier, appear to have been extended and maintained.

In 1876 the project was modified to obtain by dredging a channel of navigable width, not less than 4 feet deep at mean low water, from the mouth of the river up about  $1\frac{1}{4}$  miles to Kennebunkport, at an estimated cost of \$5,000.

By 1893 the original and modified projects were completed. A westerly pier 600 feet long, an easterly pier 290 feet long, and a wharf 300 feet long appear to have been extended and maintained, and a channel of navigable width, 4 feet deep at mean low tide, obtained by dredging and rock excavation.

In December, 1902, an estimate was submitted, amounting to \$3,500, for the repair of the two piers and the wharf, and this sum was appropriated for maintenance by the act of March 3, 1905.

The total expenditures to June 30, 1907, amounted to \$86,949.88, of which \$3,365.87 was expended for maintenance and applied to the rebuilding of the wooden portion of the wharf and in general repair of the two piers. This project is completed.

The maximum draft that could be carried at mean low water on June 30, 1906, over the shoalest part of the locality under improvement is 4 feet. The mean range of tide is 9 feet.

The head of navigation is at Kennebunkport, to which point,  $1\frac{1}{4}$  miles from its mouth, the river is navigable in fact.

The commerce benefited consists principally of coal, of which 2,000 tons was delivered on the river in 1906. An occasional vessel brings in lumber for the shipyards, of which there are two at this point.

A description of the improvement at the mouth of the river may be found in the Annual Report of the Chief of Engineers for 1870, page 506, and of the channel above the mouth, in the report for 1875, Part 2, page 434.

For reports on preliminary examinations and surveys see Annual Reports of the Chief of Engineers for 1875, Part 2, page 432, and for 1890, page 471.

<sup>a</sup> Balance of appropriation of June 6, 1900, not considered applicable under existing project.

July 1, 1906, balance unexpended.....	\$225.46
June 30, 1907, amount expended during fiscal year, for maintenance of improvement .....	91.33

July 1, 1907, balance unexpended.....	134.13
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(See Appendix A 18.)

19. *York Harbor, Maine.*—York Harbor is the mouth of York River, a small stream emptying into the Atlantic Ocean, about 10 miles east of Portsmouth, N. H. \*Originally the channel was crooked and difficult to navigate. A project was approved in 1886 for widening and straightening the channel by removing part of the spit off the southwest point of Stage Neck, removing part of a sand shoal off Bragdon's Island, and removing the upper shoal just north of Bragdon's Island, at an estimated cost of \$25,000, subsequently increased (in 1888) to \$44,000, on account of some of the material proving harder than was expected. This project was regarded as completed in 1894. The cost was \$44,000.

The existing project was adopted by the act of March 3, 1905. It provides for widening the channel off Bragdon's Island about 170 feet by dredging to the depth of 10 feet at mean low tide, and for removing to the same depth the point of a projecting shoal just above, at an estimated cost of \$13,400.

The expenditures to June 30, 1907, under the existing project were \$13,400. The project of 1905 is completed.

The mean rise of tides is 8 feet.

For reports on examinations and surveys see Annual Reports of Chief of Engineers for 1885, page 485, and for 1904, page 819.

The commerce for 1906 amounted to 27,650 tons, chiefly bricks, estimated to amount in value to \$116,075. The place is much frequented by pleasure craft during the summer.

July 1, 1906, balance unexpended.....	\$227.27
June 30, 1907, amount expended during fiscal year, for works of im- provement .....	227.27

(See Appendix A 19.)

20. *Harbor at Isles of Shoals, Maine.*—The most protected anchorage at Isles of Shoals, known as Gosport Harbor, lies between Star Island on the south and southwest, Cedar Island on the southeast, and Smuttynose Island on the north and northeast. At mean low water its anchorage of about 32 acres had a depth of 18 to 48 feet and none of its entrances less than 24 feet.

The original project of March 3, 1821, appears to have been to rebuild the small breakwater on the north side of Haleys Cove, projecting westerly from Smuttynose Island to Cedar Island, directly protecting Gosport Harbor from easterly storms.

The amount expended on the original project prior to operations under the existing project was \$13,251.61.

The existing project, adopted by the act of June 13, 1902, is to construct a breakwater on the base of the breakwater that was built under the project of 1821 between Smuttynose and Cedar islands, the upper part of which throughout its length had been demolished down to the level of  $1\frac{1}{2}$  feet above mean low water, at an estimated cost of \$30,000.

The amount expended on the work of the existing project to June 30, 1907, is \$28,201.60, all for improvement, with which the break-

water between Smuttynose and Cedar islands has been completed to the height of 15 feet above mean low water, completing the project.

The mean range of tides is 8.6 feet.

The commerce benefited by the improvement is inconsiderable, but the harbor is of value as a harbor of refuge in the open sea 6 miles off the coast.

A report of a survey of the Smuttynose Island breakwater is published in the Annual Report, Chief of Engineers, for 1875, Part 2, page 421. A description of the harbor, with survey and estimate for the new breakwater, is in the Annual Report for 1900, page 1172.

July 1, 1906, balance unexpended	-----	\$1,798.40
July 1, 1907, balance unexpended	-----	1,798.40

(See Appendix A 20.)

21. *Cocheco River, New Hampshire.*—Appropriations amounting to \$10,060, made from 1829 to 1837, inclusive, had been applied to the reduction of obstructions in the natural channel prior to the systematic improvement of this river, begun in 1870, when it was found to have a good channel not less than 6 feet deep at mean low water from its confluence with the Piscataqua River to the Lower Narrows, about  $1\frac{1}{2}$  miles below the lowest bridge at Dover. Above the Lower Narrows the channel was obstructed by ledges and shoals upon which at mean low water the depth was from 6 inches to 2 feet. The original project for systematic improvement, adopted by the act of March 3, 1871, was to obtain a channel 40 feet wide and 4 feet deep at mean low water from the Lower Narrows to the head of navigation at Dover. Under the original and amended projects completed in 1888 the amount expended prior to operations under the existing project, including the expenditures from 1829 to 1837, was \$170,060.

The existing project, adopted by the act of September 19, 1890, is to obtain a channel 60 to 75 feet wide and 7 feet deep at mean low water (in rock 50 feet wide and  $7\frac{1}{2}$  feet deep) from the mouth of the river to the head of navigation, at an estimated cost of \$175,000. By the act of June 13, 1902, this project was extended to include the restoration of the channel in the Lamprey River, which, from 1881–1883, under specific appropriations, had been dredged at mean high water 100 feet wide and 12 feet deep to the Lower Narrows and 40 feet wide and 11 feet deep to the wharves at Newmarket, N. H.

To June 30, 1907, there has been expended on the existing project for improving Cocheco River, \$137,000, as follows: Cocheco River, for improvement, \$119,089.93; for maintenance, \$9,642.54; for Lamprey River, for maintenance, \$8,267.53. As a result the channel in Cocheco River has been completed except over a small portion about 3,500 feet below Dover, where some additional ledge excavation may be necessary, the basin at Dover and the channel near the mouth, where shoaling had occurred, have been redredged, and the channel in Lamprey River has been restored to the full authorized dimensions.

The maximum draft that can be carried in Cocheco River is  $6\frac{1}{2}$  feet at mean low tide, and in Lamprey River 11 feet at high tide.

The mean range of tide is 6.8 feet.

The head of navigation is at the lowest bridge in Dover, to which point, 3 miles from its confluence with the Piscataqua River and 13 miles from the sea, the Cocheco River is navigable in fact.



The commerce for 1906 amounted to 180,265 tons. Definite figures as to the effect on freight rates brought about by the work of improvement can not be given, but great advantage has been derived, particularly in the coal trade, through the employment of somewhat larger vessels and the existence of competitive water transportation.

The original project, adopted in 1871, is published in the Annual Report of the Chief of Engineers for 1871, page 858; the existing project, adopted in 1890, in the Annual Report for 1890, page 475. A map of Cocheco River in the vicinity of Dover may be found in the Annual Report for 1885, page 474.

July 1, 1906, balance unexpended.....	\$21, 898. 36
June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$7, 544. 82
For maintenance of improvement.....	9, 642. 54
	<hr/> 17, 187. 36

July 1, 1907, balance unexpended..... 4, 711. 00  
(See Appendix A 21.)

*22. Exeter River, New Hampshire.*—In its original condition at mean high water, Exeter River was navigable from its mouth, in Great Bay, 7.8 miles, to Fernald's wharf in Exeter for vessels drawing 10 feet; thence to the upper wharves at Exeter, 0.5 mile, the depth was 5 feet.

The original project, adopted by the act of June 14, 1880, was to obtain a channel 40 feet wide from the mouth, 8.3 miles to the upper wharves at Exeter, 12 feet deep at high water 5.6 miles to Oxbow, and 10 feet deep from Oxbow to Exeter. Under this project the amount expended prior to operations under the existing project was \$35,000, with which the original project was completed.

The existing project, adopted by the act of March 3, 1899, is to obtain a channel 40 feet wide at mean high water, 12 feet deep to Oxbow and 11 feet from Oxbow to Exeter, with a turning basin 200 by 110 feet at Exeter, estimated to cost (increased estimate) \$19,000.

The amount expended under the existing project to June 30, 1907, is \$18,254.42, all for improvement, with which a channel and turning basin of the dimensions prescribed have been obtained, completing the project.

The mean range of tides is 6 feet.

The head of navigation is at the upper wharves at Exeter, to which point, 8.3 miles above its mouth, the river is navigable in fact.

The original project is described in the Annual Report of the Chief of Engineers for 1875, page 427, and the existing project in report for 1897, page 818.

July 1, 1906, balance unexpended.....	\$745. 58
July 1, 1907, balance unexpended.....	745. 58

(See Appendix A 22.)

*23. Harbor of refuge at Little Harbor, New Hampshire.*—In its original condition the entrance to Little Harbor was but 3 feet deep at mean low water, and its anchorage ground, 650 by 125 feet in area and 9 feet in depth at mean low water, was exposed to the full force of the sea.

The original, which is also the existing, project, adopted by the act of August 5, 1886, extended by act of August 11, 1888, and as reduced in 1894, is to obtain a channel 3,000 feet long, 100 feet wide, and 12

feet deep at mean low water, and an anchorage basin of the same depth 40 acres in area, and construct two breakwaters at the entrance, at an estimated cost, as revised in 1894, of \$145,000.

To June 30, 1907, the amount expended on the existing project is—for improvement, \$133,227.33; for maintenance, \$3,121.74; total, \$136,349.07, with which the project has been completed; but it may be necessary to do some work on the breakwaters from time to time.

The maximum draft over the shoalest part of the improved channel and basin is 11 feet at mean low water. The mean range of tides is 8 feet.

The commerce benefited is inconsiderable, and the improvement is designed to afford a harbor of refuge for yachts and coastwise vessels. During the year 1906, 407 vessels are reported to have anchored behind the breakwaters.

The original project is published in the Annual Report of the Chief of Engineers for 1882, page 507; the modifications, with map of the harbor, in the report for 1887, page 470.

July 1, 1906, balance unexpended.....	\$8, 650. 93
July 1, 1907, balance unexpended.....	8, 650. 93

(See Appendix A 23.)

#### EXAMINATIONS AND SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF MARCH 3, 1905.

Reports on preliminary examinations and surveys required by the river and harbor act of March 3, 1905, of the following localities within this district were duly submitted by the district officer. They were reviewed by the Board of Engineers for Rivers and Harbors, pursuant to law, and were transmitted to Congress and printed in documents, as indicated:

1. *Preliminary examination and survey of Longcove, Me., with a view to the removal of two ledges.*—Reports dated September 25, 1905, and June 22, 1906, respectively, are printed in House Document No. 213, Fifty-ninth Congress, first session. The improvement is not considered worthy of being undertaken by the United States.

2. *Preliminary examination and survey of Hendricks Harbor, Maine, with a view to rock removal.*—Reports dated September 28, 1905, and June 18, 1906, respectively, are printed in House Document No. 272, Fifty-ninth Congress, second session. The locality is not considered worthy of improvement by the United States.

3. *Preliminary examination and survey of Kennebec River, Maine, from the mouth to Gardiner.*—Reports dated September 14, 1905, and November 21, 1906, respectively, are printed in House Document No. 321, Fifty-ninth Congress, second session. The plans presented are for improvement at an estimated cost of \$275,000, with about \$2,000 annually for maintenance after completion.

4. *Preliminary examination and survey of Marsh River (South Branch of Penobscot River), at and near Frankfort, Me.*—Reports dated December 8, 1905, and August 21, 1906, respectively, are printed in House Document No. 274, Fifty-ninth Congress, second session. It is not deemed advisable for the United States to undertake improvement of this locality.

## IMPROVEMENT OF RIVERS AND HARBORS IN VERMONT, IN EASTERN MASSACHUSETTS, AND IN NEW YORK ON LAKE CHAMPLAIN.

This district was in the charge of Maj. Edward Burr, Corps of Engineers, having under his immediate orders Capt. G. R. Lukesh, Corps of Engineers, to July 14, 1906, and First Lieut. H. C. Jewett, Corps of Engineers, to November 21, 1906, and since June 11, 1907. Division engineer, Col. Amos Stickney, Corps of Engineers, to June 4, 1907, and Col. John G. D. Knight, Corps of Engineers, since that date.

1. *Newburyport Harbor, Massachusetts.*—Prior to specific appropriations for Newburyport Harbor funds applicable to Merrimac River, of which it is the estuary, were devoted to removing a sand bar and constructing a breakwater at the river's mouth, 1828 to 1836, and to removing obstructing ledges, piers, and wrecks, 1870 to 1880. In its original condition the outlet of the Merrimac River, which, between Plum Island and Salisbury Point was 1,000 feet wide and 30 feet deep at mean low water, was obstructed by a sand bar, nearly a mile outside, through which, in 1880, a narrow channel about 7 feet deep at mean low water was maintained by the current of the river.

The original project, adopted by the act of June 14, 1880, which is the existing project, is to create at the outer bar a permanent channel 1,000 feet wide and at least 17 feet deep at mean low water, by constructing two converging jetties, projecting, one from the north shore 2,910 feet, the other from the south shore, 1,500 feet, their outer ends 1,000 feet apart, which, with the protection of the beach in their vicinity, was estimated in 1881 to cost \$365,000. The direction of jetties and shore protection was modified in 1883, and in 1882 the partial closing of Plum Island Basin with a timber dike about 800 feet long and  $5\frac{1}{2}$  feet above mean low water was added to the project, increasing the cost (as estimated in 1884) to \$375,000. In 1884 a modification of the project provided for extending both jetties 610 feet parallel to the axis of the channel and in 1886 for increasing that extension to 1,000 feet, increasing the cost of the work, as estimated in 1897, to \$599,547.49.

To June 30, 1907, the amount expended on this project was \$368,133.65, of which \$5,314.58 was for maintenance. In addition, \$500 was expended in 1901 for removal of North rock under authority of act of March 3, 1899. The expenditure for maintenance in the fiscal year 1907 was applied to expenses incurred in inspection of the retopping of 100 feet of the north jetty.

With the expenditure for improvement, the north jetty has been completed for a total length of 2,705 feet and the south jetty completed except for a distance of 30 feet at its outer end; the Plum Island Basin has been closed with a timber dike 817 feet long,  $5\frac{1}{2}$  feet high above mean low water, except near the middle, where a weir 150 feet long and 2 feet above mean low water was left temporarily, and two sand catchers, respectively 480 and 572 feet in length, have been built in rear of the south jetty. Both jetties are 15 feet wide on top, which is in a plane 12 feet above mean low water, and have slopes of 1 on 2 on the seaward face and 1 on 1 on the shoreward face. The project is about 80 per cent completed.

June 30, 1907, the maximum draft that can be carried over the bar at mean low water is 12.5 feet. The mean range of tides is 7.7 feet.

The commerce of the harbor, chiefly coal, amounted in 1905 to 165,833 tons and in 1906 to 169,975 tons. Of the latter amount, 73,827 tons was reshipped to points on the Merrimac and Powow rivers.

It is reported that the improvement made has reduced freight rates 25 cents per ton, and that if the projected depth of 17 feet at mean low water be obtained over the outer bar it would still further reduce the freight rates 15 to 25 cents per ton.

The original project, as reported by a Board of Engineers, with map of the harbor, is published in Annual Report of the Chief of Engineers for 1881, page 502; the modifications in jetties and shore protection, in reports for 1883, page 437, and 1884, page 494; the parallel extension of the jetties, with map and additional estimate, in report for 1897, page 825, and a survey of the bar and entrance, in report for 1905, page 802.

A survey and map of the bar and entrance, with estimate for removing obstructions in the mouth of the river, are published in House Document No. 339, Fifty-ninth Congress, second session.

July 1, 1906, balance unexpended.....	\$30, 214. 55
June 30, 1907, amount expended during fiscal year, for maintenance of improvement .....	348. 20
July 1, 1907, balance unexpended.....	<u>29, 866. 35</u>
July 1, 1907, amount covered by uncompleted contracts.....	<u>27, 000. 00</u>
Amount (estimated) required for completion of existing project.....	206, 862. 07

(See Appendix B 1.)

2. *Merrimac River, Massachusetts.*—In its original condition the Merrimac River had a practicable channel 7 feet deep at mean low water from its mouth 9 miles to South Amesbury, but besides being narrow and crooked the channel was obstructed by ledges, boulders, and shoals.

The original projects appear to have been—

(1) For improving the bar at the mouth of the river, by erection of piers or other works, adopted by act of May 23, 1828; subsequently improved under separate project for "Improving harbor at Newburyport, Mass."

(2) For the improvement of the river above the mouth, by the removal of the remains of a dam at the upper falls and of a rock at the lower falls, of Gangway rock in Newburyport Harbor, and a wreck near the mouth of the river.

Upon the original and modified projects, prior to operations under the existing project, there were expended: Upon the project of 1828, \$67,466.72, and upon the project of 1870, as largely extended by the acts of June 23, 1874, and June 3, 1896, \$187,000; total, \$254,466.72.

The existing project, adopted by the act of March 3, 1899, is to obtain a channel 7 feet deep at mean low water, 150 feet wide, from Newburyport  $14\frac{1}{2}$  miles to Haverhill, at an estimated cost of \$171,442.70.

The amount expended on the existing project to June 30, 1907, is \$106,187.62, of which \$1,432.75 was applied to maintenance of improvement, and 10 cents derived from sales. With this expenditure the channel has been completed to the full projected depth and width up to the highway bridge at Haverhill, by dredging through eight shoals, aggregating 3 miles in length. By the expenditure for maintenance during the fiscal year 1907, the shoals in the channel at the bend, about 3,000 feet above Rocks Bridge, were removed, restoring the full projected width and depth. The dredging of the authorized channel is nearly completed.

The commerce of the river is chiefly in coal distributed to the cities and towns along its banks, and amounted in 1904 to 76,527 tons, and in 1906 to 73,827 tons. The improvement of the channel is reported to enable the delivery of coal by water at rates 35 to 50 cents per ton less than by rail.

The head of navigation is at the hat factory, one-half mile above the railroad bridge at Haverhill, to which point the stream is navigable in fact, 17½ miles above its mouth in Newburyport Harbor.

June 30, 1907, the maximum draft that can be carried at mean low water over the shoalest part of the improved channel below the highway bridge at Haverhill is 7 feet.

The mean range of tides is, at the mouth of the river, 7.7 feet, and at Haverhill bridge 4.6 feet, at low-water stage of the river.

The project of 1870-1874 is published in the Annual Report of the Chief of Engineers for 1869, page 421; as extended in 1874, in report for 1876, page 165; as extended in 1896, in report for 1896, page 616; and the existing project adopted in 1899, in report for 1897, page 865.

The report of a survey, with estimate of cost, to deepen the channel to 9 feet at mean low water, is published in Annual Report for 1904, pages 872-878.

An examination for a channel 12 feet deep to Haverhill (unfavorably reported), and a survey and estimate for removing obstructions at the mouth of the river (favorably reported) made in 1906, are published in House Document No. 339, Fifty-ninth Congress, second session.

July 1, 1906, balance unexpended.....	\$40, 035. 23
June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$24, 790. 00
For maintenance of improvement.....	1, 432. 75
	<hr/> 26, 222. 75
July 1, 1907, balance unexpended.....	13, 812. 48
July 1, 1907, outstanding liabilities.....	2, 538. 88
	<hr/> 11, 273. 60
July 1, 1907, balance available.....	
July 1, 1907, amount covered by uncompleted contracts.....	9, 774. 05
Amount (estimated) required for completion of existing project.....	52, 875. 35
(See Appendix B 2.)	

3. *Essex River, Massachusetts.*—In its original condition Essex River had a channel not less than 6 feet deep at mean low water from its mouth in Ipswich Bay for a distance of about 2½ miles; but thence for 2½ miles to the head of navigation in fact at the railroad bridge at Essex, the channel was narrow, crooked, and shallow, having a

greatest continuous depth of 1.7 feet, navigation being further impeded by bowlders obstructing the channel.

The original project, adopted July 13, 1892, which is also the existing project, is to obtain a channel 4 feet deep at mean low water and 60 feet wide to the head of navigation, at an estimated cost of \$25,000; modified, March 23, 1899, by limiting the improvement to the channel below the bridge at Essex, which had been rebuilt without a draw.

To June 30, 1907, the amount expended was \$22,150, of which \$390.79, expended in the fiscal year 1907, was for surveying the improved channel to ascertain the locality and extent of dredging necessary in maintenance. Although the completion of the channel up to the highway bridge at Essex was reported February 2, 1901, complaint was made in 1905 of an obstruction in mid-channel, and in June, 1905, a group of several bowlders, about 1,300 feet below the head of navigation and within the scope of the approved project, was removed at an expense of \$300.

By the act of March 2, 1907, \$5,000 was appropriated for the restoration of the channel in Essex River, with proviso:

That no part of this sum shall be expended unless a further amount of five thousand dollars shall be provided by the State of Massachusetts or other agency, and made subject to the order of the Secretary of War in such manner as he may direct, to be expended upon said project under his direction.

The legislature of Massachusetts passed, and the governor approved, June 24, 1907, a resolve, as follows:

That there be allowed and paid out of the treasury of the Commonwealth a sum not exceeding five thousand dollars, to be expended under the direction of the harbor and land commissioners for the improvement of Essex River, the same to be expended in conjunction with an equal amount appropriated by the Congress of the United States for the same purpose.

The maximum draft that can be carried, June 30, 1907, over the shoalest part of the locality under improvement is reported to be about 2 feet. The mean range of tides is 8.8 feet.

No freight is carried on the river, but the improvement is for the purpose of permitting the exit of about 30 fishing schooners which are built annually on the river, each of about 125 tons register, at an average cost of \$12,000.

The project, with map and report of survey, is published in the Annual Report of the Chief of Engineers for 1891, pages 676-678.

The report of a preliminary examination of the river, made in 1905, is printed in House Document No. 68, Fifty-ninth Congress, first session.

July 1, 1906, balance unexpended.....	\$3, 240. 79
Amount appropriated by river and harbor act approved March 2, 1907.....	5, 000. 00

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8, 240. 79

June 30, 1907, amount expended during fiscal year, for maintenance of improvement .....	390. 79
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July 1, 1907, balance unexpended.....	7, 850. 00
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(See Appendix B 3.)

4. *Harbor of refuge, Sandy Bay, Cape Ann, Massachusetts.*—In its original condition this bay, whose southerly shore extends about 2 miles westerly from the point of Straitsmouth Island, and thence

about 2 miles northerly to Andrews Point, had a good holding ground of sand mixed with mud, and a depth of  $7\frac{1}{2}$  to 15 fathoms at mean low water, but was fully exposed to easterly, northeasterly, and northerly gales. The original project, adopted by the act of July 5, 1884, was to build a breakwater consisting of a mound of rubblestone to the grade of 22 feet below mean low water, 40 feet wide on top, to be surmounted by a masonry wall, and to extend from Averys ledge a little west of north 3,600 feet to Abners ledge, thence 5,400 feet northwesterly in the direction of Andrews Point, covering an anchorage of about 1,377 acres.

This project, with the cross section of the breakwater as modified by a Board of Engineers February 13, 1900, is the existing project, the breakwater to consist of a mound of rubblestone built to the grade of 12 feet below mean low water, where it will have a width of 117 feet, its harbor slope to be 1 on 1, its seaward slope 1 on 1 up to 25 feet below mean low water, and 1 on 2 thence to the top, 12 feet below mean low water; the rubble mound to be surmounted with a core of rubblestone, to be faced with selected stone to be laid horizontally on the sea face, to weigh not less than 8 tons each and to be laid with a batter of 1 on 2, and on the harbor face to weigh not less than 3 tons each and be laid with a batter of 1 on 1; to be surmounted at grade 17 above mean low water with a single course of capstones, whose upper surface shall be 22 feet above mean low water; at an estimated cost (as revised in 1900) of \$6,904,952.25.

The river and harbor act of March 2, 1907, authorized a continuing contract for this work to the extent of \$100,000 in excess of the appropriations then made. This amount remains to be appropriated.

The amount expended under the existing project to June 30, 1907, not including outstanding liabilities, is \$1,387,314.59 (including \$1 derived from sales), all for improvement, with which 1,833,348 tons of rubblestone has been placed in the substructure of the breakwater, and its condition is approximately as follows:

In the southern arm for a length of 3,530 feet the mound of rubblestone has been completed up to the grade of 12 feet below mean low water, with the full width of 117 feet prescribed in the project; the rubble core of the superstructure has been built to the height of mean low water, 2,990 feet, and to the height of 5 feet above mean low water for 540 feet farther.

In the western arm for a length of 1,710 feet from the angle the mound of rubblestone has been likewise completed to the full height (12 feet below mean low water) and full width (117 feet) projected, except for a small bench on the inner slope 13 feet deep and 17 feet wide, and stone has been deposited for a farther distance of 490 feet without regular form; a rubble core of the superstructure has been built to the height of mean low water for 1,310 feet and to the height of mean high water for 400 feet.

The depth of water is ample for the largest vessels; the mean range of tides is 8.6 feet.

Thirty-seven per cent of the total quantity of rubblestone has been deposited in the substructure, which is approximately 28 per cent of the entire quantity of stone of all classes required for the breakwater.

The available balance and the estimated amount that can be profitably expended will be applied to the further extension of the rubble-

stone mound in the western arm up to the plane of mean low water and to building superstructure on the southern and western arms.

The improvement is chiefly of value in providing refuge for coast-wise vessels, especially towed barges, which are frequently and suddenly in urgent need of shelter in fog and snowstorms.

For description of Sandy Bay and original project, see Annual Report of the Chief of Engineers for 1884, pages 565-577. For cross section, details of construction, and increase in cost, see report of Board of Engineers, Annual Report for 1900, page 1183.

July 1, 1906, balance unexpended.....	\$199,426.72
Receipts from sales.....	1.00
Amount appropriated by river and harbor act approved March 2, 1907.....	100,000.00
	<hr/>
	299,427.72
• June 30, 1907, amount expended during fiscal year, for works of improvement.....	36,741.31
	<hr/>
July 1, 1907, balance unexpended.....	262,686.41
July 1, 1907, outstanding liabilities.....	17,554.40
	<hr/>
July 1, 1907, balance available.....	245,132.01
	<hr/>
July 1, 1907, amount covered by uncompleted contracts.....	127,819.60
Amount (estimated) required for completion of existing project..	5,254,952.25
	<hr/>
{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907.....	
Submitted in compliance with requirements of sundry civil act of June 4, 1897.	
	100,000.00

(See Appendix B 4.)

5. *Harbor at Gloucester, Mass.*—In its original condition this harbor, which had a depth sufficient for the largest ships, contained several very dangerous submerged rocks and was entirely without protection against the sea and against heavy swells from the south.

The original project, adopted by the act of June 10, 1872, appears to have been for removal of five rocks, at an estimated cost of \$10,606.20.

Under the original and modified projects the rocks were removed, Harbor Cove was dredged to the depth of 10 feet at mean low water, and the water front for a distance of 3,900 feet northeast from Fort Point was dredged to a depth of 15 feet at mean low water from the 15-foot contour to the wharf front, upon which there was expended prior to operations under the existing project approximately \$86,000.

The existing project, adopted by the act of August 18, 1894, as curtailed by the act of June 13, 1902, is to build under continuing contract a breakwater from the shore about 2,250 feet to a point at or near Cat ledge, and upon completion of the breakwater to apply any balance remaining "toward the work of removing Round rock," at an estimated cost of \$416,083.43.

The breakwater consists of a mound of rubblestone 31 feet wide at the top at mean low water, surmounted by a superstructure extending 17 feet above the grade of mean low water, formed by two dry walls of heavy split stone, inclosing a core of rubblestone, capped by heavy stones, forming a top course 10 feet in width, the slopes of the rubble



structure being on the harbor side 1 on 1.3, on the seaward side 1 on 3 to grade 12 below mean low water, and 1 on 1.5 thence to the bottom.

The amount expended under the existing project to June 30, 1907, not including outstanding liabilities, is \$410,239.16, all for improvement, with which 231,756 tons of stone has been put in place, completing the breakwater of the projected dimensions, including an expansion at its outer end for a site for a light-house.

The maximum draft that can be carried June 30, 1907, at mean low water over the shoalest part of the locality under improvement is 10 feet in Harbor Cove, 15 feet along the wharf front, and 30 feet in the anchorage under the breakwater.

The mean range of tides is 8.9 feet.

The commerce in 1904 amounted to 263,526 tons and in 1906 to 275,888 tons, of which 70,000 tons was coal and 159,000 tons fish and salt. About 80,000 passengers were carried to and from this port by steamer.

It is proposed to apply the available balance toward the removal of Round rock.

A description of the original project is published in the Annual Report of the Chief of Engineers for 1871, page 870, and its modifications, with map, in the report for 1887, page 500.

The adoption and the commencement of work under the existing project are reported upon in the Annual Report of the Chief of Engineers for 1895, page 610.

July 1, 1906, balance unexpended.....	\$18,090.24
June 30, 1907, amount expended during fiscal year, for works of improvement .....	12,246.40

July 1, 1907, balance unexpended.....	5,843.84
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(See Appendix B 5.)

6. *Harbor at Manchester, Mass.*—In its original condition Manchester Harbor had a good channel 100 feet wide and not less than 6½ feet deep at mean low water, extending from the bay 3,200 feet to Proctors Point. At that distance the channel shoaled rapidly to a depth of 1½ feet at the Narrows, 1,400 feet from Proctors Point, and for the remaining distance, 2,600 feet, to the town wharves there was no practicable channel at low water.

The original project, adopted by the act of August 11, 1888, was to dredge a channel 60 feet wide and 4 feet deep at mean low water from Proctors Point, a distance of 4,000 feet, to the town wharves, at an estimated cost of \$14,300.

The amount expended under the original project and prior to operations under the existing project was \$14,300, obtaining a channel of the length, depth, and width prescribed in the project, expanded opposite the town wharves to the width of 80 feet; but the dredged channel deteriorated rapidly and thereafter there was some shoaling at the entrance.

The existing project, adopted by the river and harbor act of March 3, 1899, is to dredge the natural channel to the depth of 6 feet at mean low water from that depth in the bay, a distance of 7,200 feet, to the town wharves, 100 feet wide at the entrance and at the sharpest bends and at least 75 feet wide throughout, with two turning basins, one 200 feet by 300 feet in area just below the drawbridge of the

Boston and Maine Railroad and the other 125 feet by 250 feet at the town wharves, for which the estimated cost is \$25,000.

Under this project to the close of the fiscal year ending June 30, 1907, the amount expended is \$9,685.57, all for improvement, with which a channel has been obtained of the full projected width and depth from the entrance to a point 220 feet below the southwest corner of Read's wharf, except that two small ledges, projecting about 20 feet, obstruct the eastern side of the channel about west of Proctors Point. The project is 31 per cent completed.

It is reported that the maximum draft that can be carried June 30, 1907, over the shoalest part of the locality under improvement is 1 foot at mean low water. The mean range of tides is 9 feet.

The commerce of the harbor benefited by the improvement consists chiefly of coal and building materials for local consumption, of which about 12,000 tons was reported received in 1900, and 4,850 in 1906.

The work done is of no appreciable commercial benefit and can have no appreciable effect on freight rates. The completion of the project would probably enable the local supply of coal and building materials to be brought in more cheaply.

The original project, with map of survey, is in the Annual Report of the Chief Engineers for 1888, page 466.

The existing project, with map of survey, is published in the Annual Report of the Chief of Engineers for 1897, page 869.

In pursuance of a resolution of the Committee on Rivers and Harbors of the House of Representatives, the Board of Engineers for Rivers and Harbors has considered the project for this work, and in its report (Annual Report, 1904, p. 840) recommends, in order to make available for commerce the portion of the improvement already accomplished, that the United States complete the work under the existing project, but modified as follows: A channel 6 feet deep and 75 feet wide and at the turns 100 feet wide, to be excavated from the entrance to the town wharves, and a turning basin 125 feet by 250 feet at the town wharves, for the estimated cost, exclusive of amounts heretofore appropriated, of \$18,117, toward which it is proposed to apply the available balance as a profitable expenditure.

July 1, 1906, balance unexpended.....	\$314. 43
July 1, 1907, balance unexpended.....	314. 43

Amount (estimated) required for completion of existing project..... 15, 000. 00

(See Appendix B 6.)

7. *Harbor at Beverly, Mass.*—In its original condition this harbor had a practicable channel 18 feet deep at mean low water from Monument bar beacon about 1 mile to its head, about 600 feet below the highway bridge, sufficient for the commerce of the harbor and of its three tributary streams, called, respectively, North River, Essex Branch, and Beverly Creek; but the channel, which is circuitous in its passage through the shoals at the entrance, was found in 1900 to be "of insufficient width for safe navigation by heavy vessels."

The original project, adopted by the act of June 13, 1902, was to widen the channel from Monument bar beacon to a point about 200 feet east of Rams Horn beacon to a width of 200 feet, with a depth of 18 feet at mean low water, at an estimated cost of \$10,000. Upon the original project, prior to operations under the existing project,

\$8,272.10 was expended, with which the channel was enlarged to the dimensions authorized, except at three points, where the width was restricted by ledges to 106 feet.

The existing project, adopted by the act of March 2, 1907, is to obtain, by dredging and rock excavation, a channel 18 feet deep at mean low water, not less than 250 feet wide at the bend for a distance of about 3,200 feet from Bar beacon to Lobster rocks beacon, including the removal of the middle ground, and not less than 200 feet wide from Lobster rocks beacon to the lower end of the draw pier at the highway bridge, at an estimated cost of \$40,000. In addition to \$1,727.90 available, \$38,500 was appropriated.

To the close of the fiscal year ending June 30, 1907, \$30.80 has been expended on this project. A contract has been made for all the dredging necessary to complete the project. By way of refundment, \$122.24 was received as damages from the surety of a failing contractor under the previous project.

The maximum draft that can be carried on June 30, 1907, at mean low water over the shoalest part of the locality under improvement is 18 feet. The mean range of tides is 9 feet.

The commerce of Beverly Harbor consists chiefly of coal and building materials, amounting in 1906 to 138,862 tons, of which 100,613 was coal.

It is expected by those locally interested in shipping that the completion of the project will effect a substantial reduction in freight rates, which to this time have not been appreciably affected by the improvement in progress.

The report of a survey of this harbor is published in the Annual Report of the Chief of Engineers for 1890, page 524. The project of 1902, with report of survey, is in the Annual Report for 1901, page 1065.

The existing project, with report of survey and map, is published in House Document No. 916, Fifty-ninth Congress, first session.

July 1, 1906, balance unexpended.....	\$1, 727. 90
Damages from surety of failing contractor.....	122. 24
Amount appropriated by river and harbor act approved March 2, 1907.....	38, 500. 00
	<hr/>
	40, 350. 14
June 30, 1907, amount expended during fiscal year, for works of improvement.....	30. 80
July 1, 1907, balance unexpended.....	<hr/> 40, 319. 34
July 1, 1907, amount covered by uncompleted contracts.....	<hr/> 16, 940. 00

(See Appendix B 7.)

8. *Harbor at Lynn, Mass.*—An area of shoals extends from the wharves at Lynn  $2\frac{1}{2}$  miles southerly to the sea. It is protected from the sea by the peninsula of Lynn Beach and Nahant.

In its original condition three narrow and crooked channels, in which the depth was but 6 feet at mean low water, extended from the wharves to the sea.

The original project, defined in the report of a Board of Engineers dated April 10, 1884, and as modified in 1888, was to dredge a channel 200 feet wide and 10 feet deep at mean low water from the sea (at White rocks), a distance of 3,300 feet to a deep basin opposite Little

Nahant, and from the basin nearly opposite Sand Point, a distance of 6,900 feet to a point 400 feet inside the harbor line, and an anchorage basin 500 feet by 300 feet and 10 feet deep at mean low water; the upper part of the channel to be maintained by occasional dredging, the lower part by a training wall joining the land at Little Nahant, at an estimated cost of \$182,000.

The amount expended on this project was \$122,063.56, all for improvement, with which the entire channel and the anchorage basin as prescribed in the project were completed.

The existing project, adopted by the river and harbor act of June 13, 1902, is to dredge the channel 200 feet wide from the sea to the anchorage basin and the anchorage basin itself to the depth of 15 feet at mean low water, at an estimated cost of \$162,937. Under this project to the close of the fiscal year ending June 30, 1907, \$132,465.56 has been expended, all for improvement, with which the projected channel has been completed, except the removal, now in progress, of numerous small shoals left in dredging. The work is being done under continuing contract, for which the full amount of the estimate has been appropriated.

The maximum draft that can be carried June 30, 1907, over the shoalest part of the locality under improvement is 15 feet at mean low water. The mean range of tides is 9.3 feet.

The commerce of the harbor benefited by the improvement consists chiefly of coal, lumber, and building materials, of which about 343,784 tons was carried during the year. The deepening of the channel to 10 feet enables barges to carry full cargoes of coal to the wharves at Lynn during the highest stages of the tide; the improvement to 15 feet will enable the smaller or medium size barges to carry full cargoes of coal to the wharves at all stages of the tide and barges of the greatest draft during the higher stages.

It is reported that the cost of transportation has been reduced 25 cents a ton by deepening the channel to 10 feet, and will be further reduced 10 to 25 cents upon the completion of the 15-foot channel.

The original project approved by the Secretary of War April 21, 1884, is in the Annual Report of the Chief of Engineers for 1884, page 524, and the map of the harbor at page 532.

The existing project was published in the Annual Report of the Chief of Engineers for 1901, page 1093.

July 1, 1906, balance unexpended.....	\$98, 918. 44
June 30, 1907, amount expended during fiscal year, for works of improvement .....	62, 010. 56
July 1, 1907, balance unexpended.....	36, 907. 88
July 1, 1907, outstanding liabilities.....	19, 772. 88
July 1, 1907, balance available.....	17, 135. 00
July 1, 1907, amount covered by uncompleted contracts.....	16, 643. 33

(See Appendix B 8.)

9. *Mystic and Malden rivers, and Mystic River below the mouth of Island End River, Massachusetts.*—(a) *Mystic River.*—In its original condition the Mystic had a practicable channel 6 feet deep at mean low water extending to Dennings Landing, 3.9 miles above its mouth in Boston Harbor, and 4 feet deep at mean low water about 2,000 feet farther.

The original project for improvement, adopted by the act of July 13, 1892, which is also the present project, is to make the channel 100 feet wide and 6 feet deep at mean low water from the Boston and Maine Railroad (Western Division) bridge up about 1 mile to the first turn above Denning's wharf; and thence 2 miles to the head of navigation at Medford, 4 feet deep at mean low water, gradually narrowing from 100 feet to 50 feet at the upper end, at an estimated cost of \$25,000.

The amount expended to close of the fiscal year, June 30, 1907, is \$28,794.88, with which the projected channel was completed in November, 1906.

The maximum draft that can be carried, June 30, 1907, at mean low water is 6 feet up to the first turn above Denning's wharf, and thence to the head of navigation 4 feet. The mean range of tides is 9.8 feet.

The head of navigation is the upper limit of that part of the channel under improvement, at the stone bridge at Medford, to which point, 6 miles above its confluence with the Charles River in Boston Harbor, the stream is navigable in fact.

The commerce benefited by this improvement, chiefly coal, amounted in 1904 to 25,965 tons, and in 1906 to 17,500 tons. It is reported that as the smallest barges go out of use the improvement will permit barges of the lightest draft remaining in service to deliver coal at Medford without the expense of lightering, which would be about 50 cents per ton.

A report, with map of the survey of Mystic River and description of the project, is in the Annual Report of the Chief of Engineers for 1891, page 674.

Report of an examination of the river, with a view to its improvement to the upper limits of the city of Somerville, ordered by the act of March 3, 1905, is printed in House Document No. 144, Fifty-ninth Congress, first session.

July 1, 1906, balance unexpended.....	\$8,824.29
Transfer from Mystic River below mouth Island End River.....	3,994.88
Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	<sup>a</sup> 10,000.00
	<hr/> 22,819.17
June 30, 1907, amount expended during fiscal year, for works of improvement.....	12,619.17
July 1, 1907, balance unexpended.....	10,200.00

(b) *Malden River.*—In its original condition the Malden had a practicable channel 4 feet deep at mean low water, extending only 2,000 feet above its confluence with the Mystic.

The original project, adopted by the act of August 2, 1882, was to make the channel 100 feet wide and 12 feet deep at mean high water to the Charles Street Bridge, about 1.8 miles above its confluence with the Mystic, at an estimated cost of \$35,000.

The amount expended on the Malden River under the original project and prior to operations under the existing project was \$10,000, in obtaining a channel with a least width of 50 feet and 70 feet at

<sup>a</sup> Not yet specifically allotted; temporarily accounted for under this work until definite allotment is made.

turns, with a depth of 12 feet at mean high water from the mouth to the Medford Street Bridge at Malden, a distance of  $1\frac{1}{4}$  miles.

The existing project, adopted by the act of July 13, 1892, is to dredge a channel 12 feet deep at mean high water 100 feet wide to the Medford Street Bridge, 1.6 miles above its confluence with the Mystic, and 75 feet wide about 1,200 feet farther to the Charles Street Bridge, at an estimated cost of \$37,000.

The amount expended under the existing project to June 30, 1907, is \$39,200 (including \$24,213.61 for maintenance), with which in 1897 a channel was completed 100 feet wide and 12 feet deep at mean high water up to the Medford Street Bridge. The local officer has reported the river above this bridge to be unworthy of improvement by the United States at this time. With the expenditure of \$5,346.28 in the fiscal year 1906 and \$8,317.72 in the year 1907, the improved channel has been redredged with a least width of 75 feet, increased at the bends to 100 feet, with the authorized depth of 12 feet at mean high water.

The maximum draft that can be carried at mean high water, June 30, 1907, through the improved channel is 12 feet. The mean range of tides is 9.8 feet.

The head of navigation is at the Medford Street Bridge at Malden, to which point the stream is navigable in fact, 1.6 miles above its confluence with the Mystic River.

The commerce amounted in 1904 to 75,225 tons, and in 1906 to 90,815 tons, chiefly coal. The improvement is reported to enable the smallest barges, or larger barges with partial cargoes, to deliver coal at Malden, saving the cost of lightering—50 cents per ton.

A report of the survey of Malden River and description of the original project is on page 532, Annual Report of the Chief of Engineers for 1881.

The modifications of the project are stated in the Annual Report of the Chief of Engineers for 1900, page 1191.

The existing project is described on page 672, Annual Report of the Chief of Engineers for 1891.

July 1, 1906, balance unexpended.....	\$9, 117. 72
Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	<sup>a</sup> 10, 000. 00
	<hr/> 19, 117. 72
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	8, 317. 72
	<hr/> 10, 800. 00
July 1, 1907, balance unexpended.....	10, 800. 00

(c) *Mystic River below the mouth of Island End River.*—Island End River is  $1\frac{1}{4}$  miles above the mouth of the Mystic, at the navy-yard in Charlestown, and 2,700 feet above the Chelsea drawbridge over the Mystic.

In its original condition the Mystic up to Island End River had a narrow channel 14.4 feet deep at mean low water, but so narrow above the drawbridge as to be barely practicable.

The original project, adopted by the act of March 3, 1899, which is also the existing project, is to dredge a channel 25 feet deep at mean

<sup>a</sup> Not yet specifically allotted; temporarily accounted for under this work until definite allotment is made.

low water and 300 feet wide, embracing 1.7 miles of the Mystic, extending from its mouth to a point 800 feet above Island End River, at a cost estimated in August, 1899, at \$267,547.50 (reduced estimate).

To June 30, 1907, \$96,005.12 (all for improvement, except \$281.92 for maintenance) had been expended in obtaining a channel 25 feet deep at mean low water, with a minimum width of 150 feet off the East Boston wharves, 200 feet wide thence to Chelsea bridge, and 300 feet from Chelsea bridge to a point just above the confluence of the Island End River. The project is about 45 per cent completed.

With funds appropriated by the act of March 2, 1907, the dredging below Chelsea bridge will be completed in conjunction with the dredging in the same locality for the 35-foot channel of Boston Harbor.

The commerce of the river, which in 1901 amounted to 1,430,650 tons, had increased to 3,707,817 tons in 1906, a gain of 160 per cent in four years. About three-fourths of all the freight carried on the river is coal.

The maximum draft that can be carried June 30, 1907, over the shoalest part of the locality under improvement is at mean low water 25 feet. The mean range of tides is 9.6 feet.

July 1, 1906, balance unexpended.....	\$3,994.88
Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	40,000.00
	<hr/> 43,994.88
Transfer to Mystic River.....	3,994.88
	<hr/> 40,000.00
July 1, 1907, balance unexpended.....	40,000.00
Amount (estimated) required for completion of existing project....	<hr/> <hr/> 131,824.30

#### CONSOLIDATED.

July 1, 1906, balance unexpended.....	\$21,936.89
Amount appropriated by river and harbor act approved March 2, 1907..	60,000.00
	<hr/> 81,936.89
June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$12,619.17
For maintenance of improvement.....	8,317.72
	<hr/> 20,936.89
July 1, 1907, balance unexpended.....	61,000.00
Amount (estimated) required for completion of existing project....	<hr/> <hr/> 131,824.30

(See Appendix B 9.)

10. *Harbor at Boston, Mass.*—In its original condition the headlands and islands were without protection against the sea, which was extensively eroding them. Dangerous rocks obstructed the approach and entrance from Nantasket Roads to the lower main ship channel through the Narrows. That channel was 23 feet deep at mean low water with a least width of 150 feet. The upper main ship channel from President Roads to Boston had a least depth of 18 feet at mean low water with a least width of 100 feet. The channel from President Roads to Broad Sound in the ocean had a least depth of 29 feet at mean low water with a least width of 200 feet.

The original project, adopted by the act of March 2, 1825, was "for the preservation of the islands in Boston Harbor, necessary to the security of that place," and until 1866 all expenditures, amounting to \$546,526.10, appear to have been applied to that purpose in the building and repair of sea walls. The amount expended upon them since 1866 can not be accurately stated.

The project for the improvement of the harbor adopted by the act of March 2, 1867, was (as modified) to make the main ship channel from Nantasket Roads to Boston 23 feet deep at mean low water, 600 feet wide through the Narrows to President Roads, and 1,000 feet wide from President Roads to Boston.

Prior to operations under the six existing projects (three for the improvement of the main channels and three for the improvement of tributary channels) 3.75 miles of sea walls had been built, protecting the most exposed headlands and islands, and a channel had been completed 23 feet deep at mean low water from Nantasket Roads to Boston, with a least width of 625 feet in the Narrows and of 850 feet between President Roads and the city.

The amount expended on original and modified projects upon sea walls and channels, for improvement and maintenance, to June 30, 1907, exclusive of all expenditures upon operations under the six existing projects, is \$2,539,675.82 (\$122.25 derived from sales).

The projects for improvement of the main channels under which operations were carried on during the fiscal year are—

1. Adopted by the river and harbor act of July 13, 1892. To widen the main ship channel, from Nantasket Roads to Boston, to 1,000 feet, and to deepen it to 27 feet at mean low water, at an estimated cost of \$1,250,000, subsequently increased to \$1,488,751. Project completed.

2. Adopted by the river and harbor act of March 3, 1899. To widen the Broad Sound channel to 1,200 feet, and to deepen it to 30 feet at mean low water, at an estimated cost of \$455,000. Project completed.

3. Adopted by the river and harbor act of June 13, 1902. To provide channels 35 feet deep at mean low water, 1,200 feet wide from the navy-yard at Charlestown and the Chelsea bridge and Charles River bridge to President Roads, and 1,500 feet wide from President Roads through Broad Sound to the ocean, at an estimated cost of \$7,994,000 in round numbers. This estimate differs from any made in the project quoted in the act as the basis of the appropriation, owing to the different width of the channels adopted. (To avoid a large amount of rock excavation the 35-foot channel from President Roads to Broad Sound is in a different location from the 30-foot channel.)

Under the project of July 13, 1892, to June 30, 1907, not including outstanding liabilities, the amount expended was \$1,450,001.13, of which \$58,215.30 was for maintenance, and \$10 derived from sales. With the total amount expended under this project the upper and lower main ship channels from Boston to President Roads and from President Roads to the sea have been dredged to the width of 1,000 feet and depth of 27 feet at mean low water. In the upper main ship channel the full width and depth are available. In the lower main ship channel the available width of the 27-foot channel is contracted by shoals to 650 feet.



The maximum draft that can be carried at mean low water, June 30, 1907, over the shoalest part of the locality under improvement is 27 feet.

A map of the project is in the Annual Report of the Chief of Engineers for 1894, page 554.

Under the project of March 3, 1899, to June 30, 1907, the amount expended was \$385,200, all for improvement, with which a channel 1,200 feet wide and 30 feet deep at mean low water was dredged from President Roads to Broad Sound, embracing the dredging of 965,383.9 cubic yards of sand, gravel, and clay and 198.864 cubic yards of bowlders and the removal of 156 cubic yards of ledge.

The maximum draft that can be carried at mean low water, June 30, 1907, over the shoalest part of the locality under improvement is 30 feet.

The project is published in Annual Report of the Chief of Engineers for 1898, page 886.

Under the project of June 13, 1902, a channel 35 feet deep at mean low water, 540 feet wide from the navy-yard and the Charles River bridge and Chelsea bridge to President Roads, and 675 feet wide from President Roads through Broad Sound to the ocean, is being obtained by the expenditure of \$3,600,000 authorized by the river and harbor act of that date. Of this amount \$2,900,000 is being applied to dredging under continuing contracts to be completed December 31, 1907, and \$700,000 to rock excavation, for which one contract involving the expenditure of about \$264,880 is nearly completed.

To June 30, 1907, the amount expended, not including outstanding liabilities, was \$2,040,344.78 (of which \$55.89 was derived from sales), all for improvement, with which 6,937,232 cubic yards of mud, sand, gravel, and clay and 14.222 cubic yards of bowlders have been dredged from the upper main ship channel and 1,275,657 cubic yards of mud, sand, gravel, clay, hardpan, and cobblestones and 6.222 cubic yards of bowlders have been dredged from Broad Sound channel. The dredging necessary to obtain the channels of partial width, described in the preceding paragraph, was commenced in 1903, and is about 84 per cent completed. No continuous channel with the depth of 35 feet at mean low water has yet been obtained.

By the river and harbor act of March 2, 1907, Congress authorized the completion of the 35-foot channel to the full projected widths, appropriating \$500,000 for the purpose and authorizing contracts to the amount of \$3,894,000 additional, which remains to be appropriated. The appropriation recommended will be applied to dredging and rock excavation under continuing contracts.

A map of the project is published in the Annual Report of the Chief of Engineers for 1903, page 768.

The mean range of tides is 9.5 feet at Boston light and 9.6 feet in the upper harbor.

The foreign exports and imports for the port of Boston during the calendar year ending December 31, 1906, amounted in value to \$209,703,986, being an increase of \$143,017,465 over the valuation in 1867, when the systematic improvement of the channels was begun.

As to the effect of the improvement on freight rates, the general manager of the principal foreign steamship lines entering this port states that about thirty years ago steamers were employed with a

loaded draft of 20 feet to 24 feet; twenty-two or twenty-three years ago, of 25 to 26 feet; fourteen years ago, 27 or 28 feet; ten years ago, 28 feet 9 inches; later, 31 feet, and recently one of 33 feet 10½ inches. He states, generally—

that freight rates, caused by the larger class of steamers being used, are about 50 per cent less than they were some fifteen or twenty years ago, when very much smaller steamers were engaged in the trade.

*Tributary channels.*—(a) *Charles River.*—In the original condition of the 9 miles of natural channel of this river, from its mouth to the dam at the head of navigation at Watertown, the depth at mean low water, from the mouth 4¼ miles to the Western Avenue Bridge, was not less than 7 feet, except in several places, covering about 1½ miles, below Brookline Bridge, where the depth varied from 4½ to 7 feet. From Western Avenue Bridge 2½ miles to the Arsenal Street Bridge the depth was 4 feet. Thence 1¾ miles to the dam it varied between 0 and 9½ feet.

The original project, adopted by the act of June 14, 1880, which is also the existing project, is to widen and deepen the natural channel so that at mean low water it shall be from its mouth to Western Avenue Bridge 200 feet wide and not less than 7 feet deep; thence to Market Street Bridge 80 feet wide and 6 feet deep; thence to the dam 60 feet wide and 2 feet deep; at an estimated cost of \$125,000.

The amount expended to June 30, 1907, is \$57,500, all for improvement, with which the channel has been completed as prescribed in the project up to the Arsenal Street Bridge (now called also Western Avenue Bridge). The project has been 40 per cent completed.

The maximum draft that can be carried June 30, 1907, at mean low water over the shoalest part of the locality improved is 6 feet. The mean range of tides is 9.3 feet.

The head of navigation is at the dam at Watertown, the upper limit of that part of the channel under improvement, to which point, 9 miles above its confluence with Mystic River in Boston, the stream is navigable in fact.

The improvement serves the local commerce in coal, which in 1906 amounted to 113,341 tons, enabling it to be delivered without breaking cargoes at Boston, saving the cost of one handling and the greater cost of transportation from Boston by rail.

The district officer is of opinion that so much of the existing project as provides for a channel from Brackett's wharf to Market Street Bridge, a distance of about 1,300 feet, and from Market Street Bridge to the dam at Watertown, is unworthy of prosecution by the General Government. This opinion is concurred in. The river and harbor act of September 19, 1890, appropriated \$20,000 for continuing improvement of Charles River—

*Provided,* That no expenditure of said twenty thousand dollars shall be made until the draws in the Arsenal Street and Market Street bridges shall be made to conform to the projected channel without cost to the United States.

The Arsenal Street Bridge has been altered to conform to the projected channel, and as the Market Street Bridge is above the limits to which it is now believed that the channel should be extended, it is recommended that Congress authorize the expenditure of the \$20,000 appropriated in 1890 in obtaining a channel of the projected width

and depth to Brackett's wharf and in maintaining the Charles River improvement.

A full description of the project, together with map of the river showing the progress of the improvement to this date, is on page 512, Annual Report of the Chief of Engineers for 1884.

(b) *Fort Point channel*.—In its original condition the mid-channel depth was 12 feet at its mouth and 16 feet thence to the Federal Street Bridge, excepting at the draw in the Congress Street Bridge, where it was 14.5 feet at mean low water.

The original project, adopted by the act of August 5, 1886, which is also the existing project, is to dredge a channel 175 feet wide and 23 feet deep at mean low water from the entrance about 4,190 feet to near Federal Street Bridge, at an estimated cost of \$100,000, reduced in 1887 to \$78,750. To June 30, 1907, there had been expended, not including outstanding liabilities, \$55,747.43, all for improvement, with which the projected channel was completed, except the removal, now in progress, of numerous small shoals left in dredging.

The maximum draft that can be carried June 30, 1907, at mean low water over the shoalest part of the improved channel is 23 feet. The mean range of tides is 9.6 feet.

The head of navigation is the southern extremity of South Bay, at Massachusetts avenue, Boston, Mass., to which point, about 2 miles from the entrance to the channel in Boston Harbor, the channel is navigable in fact.

The commerce benefited by this improvement consists of coal, sugar, building materials, and miscellaneous merchandise, which amounted in the calendar year 1905 to 1,463,914 tons, and in 1906 to 1,416,671 tons.

For a description of the project see Annual Report of the Chief of Engineers for 1888, page 452.

(c) *Chelsea Creek*.—In its original condition it had a channel of practicable width extending 11,000 feet from its confluence with Mystic River in Boston Harbor and 18 feet deep at mean high water, except on a bar about 2,000 feet below its head, upon which the depth was 17 feet. In the 3,300 feet from the head of the 18-foot channel to the head of navigation the depth gradually shoaled to 13 feet at mean high water.

The original project adopted by the act of June 3, 1896, which is also the existing project, is to make the channel about 5,500 feet in length next below the head of navigation, 150 feet wide, and 18 feet deep at mean high water, at an estimated cost of \$65,000.

The amount expended under this project to June 30, 1907, is \$73,071.49, all for improvement, with which the channel has been completed in accordance with the project.

The head of navigation is at the bridge of the Boston and Maine Railroad, to which point the stream is navigable in fact 700 feet above Proctor's wharf and 2.7 miles above its confluence with Mystic River.

June 30, 1907, the maximum draft that can be carried at mean high water over the shoalest part of the improved channel is 18 feet. The mean range of tides is 9.6 feet.

The commerce benefited by this improvement, consisting chiefly of coal, amounted in 1904 to 4,655 tons and in 1906 to 5,894 tons.

A report of the project and survey is in Annual Report of the Chief of Engineers for 1895, page 648.

## PROJECT FOR GENERAL IMPROVEMENT.

July 1, 1906, balance unexpended .....	\$112,080.08
Receipts from sales .....	1.00
Amount appropriated by river and harbor act approved March 2, 1907 .....	50,000.00
	<hr/>
	162,081.08
June 30, 1907, amount expended during fiscal year:	
For works of improvement .....	\$66,210.04
For maintenance of improvement .....	6,012.24
	<hr/>
	72,222.28
July 1, 1907, balance unexpended .....	89,858.80
July 1, 1907, outstanding liabilities .....	10,917.10
	<hr/>
July 1, 1907, balance available .....	78,941.70
July 1, 1907, amount covered by uncompleted contracts .....	1,709.14

## PROJECT OF 1892 FOR 27-FOOT CHANNEL.

July 1, 1906, balance unexpended .....	\$58,711.67
Receipts from sales .....	10.00
	<hr/>
	58,721.67
June 30, 1907, amount expended during fiscal year:	
For works of improvement .....	\$2,986.41
For maintenance of improvement .....	130.10
	<hr/>
	3,116.51
July 1, 1907, balance unexpended .....	55,605.16
July 1, 1907, amount covered by uncompleted contracts .....	21,408.00

## PROJECT OF 1899 FOR 30-FOOT CHANNEL THROUGH BROAD SOUND.

July 1, 1906, balance unexpended .....	\$69,800.00
July 1, 1907, balance unexpended .....	69,800.00

## PROJECT OF 1902 FOR 35-FOOT CHANNEL.

July 1, 1906, balance unexpended .....	\$1,166,254.23
Receipts from sales .....	55.89
Amount appropriated by river and harbor act approved March 2, 1907 .....	500,000.00
Amount appropriated by sundry civil act approved March 4, 1907 .....	930,000.00
	<hr/>
	2,596,310.12
June 30, 1907, amount expended during fiscal year, for works of improvement .....	536,599.01
July 1, 1907, balance unexpended .....	2,059,711.11
July 1, 1907, outstanding liabilities .....	226,503.07
	<hr/>
July 1, 1907, balance available .....	1,833,208.04
July 1, 1907, amount covered by uncompleted contracts .....	769,472.47
Amount (estimated) required for completion of existing project .....	3,894,000.00

{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907 .....

{ Submitted in compliance with requirements of sundry civil act of June 4, 1897. 900,000.00

(See Appendix B 10.)

11. *Dorchester Bay and Neponset River, Massachusetts.*—Dorchester Bay is at the mouth of Neponset River, in Boston Harbor. The present controlling depth at mean low water in the bay up to Commercial Point, at the mouth of the river, is 13 feet; thence up the river to the highway bridge at Neponset,  $1\frac{1}{2}$  miles above its mouth, it is 8 feet, and from said bridge up to Milton Mills, 4 miles above its mouth, and the head navigation, it is  $3\frac{1}{2}$  feet.

The original project, which is also the existing project, adopted by the act of March 2, 1907, is to obtain by dredging a channel 175 feet wide and 18 feet deep at mean low water through Dorchester Bay and the mouth of the river to Commercial Point; and 100 feet wide and 15 feet deep at mean low water in Neponset River from Commercial Point to the Neponset highway bridge; estimated to cost \$125,233.34.

The act of March 2, 1907, appropriated the full amount of the estimate, with the proviso:

That no part of this sum shall be expended until the Secretary of War shall have received satisfactory assurance that the improvement of that portion of the Neponset River described in said House document [No. 83, 59th Cong., second session], which lies above the project herein adopted, shall be made and hereafter maintained by the State of Massachusetts or other agency without expense to the Government of the United States.

The improvement contemplated under this proviso is to secure a channel 6 feet deep from Neponset highway bridge to Milton Mills, 100 feet wide between the said bridge and the Granite bridge, 75 feet wide thence to Godfrey's wharf, and thence 50 feet wide for a further distance of 250 feet.

The estimated amount for completing the improvement above the Neponset River highway bridge was appropriated by the following resolve of the legislature of Massachusetts, approved by the governor June 24, 1907:

That there be allowed and paid out of the treasury of the Commonwealth a sum not exceeding thirty-four thousand two hundred and seventy dollars and forty-four cents to be expended under the direction of the harbor and land commissioners in the improvement of that part of the Neponset River which lies above the Neponset highway bridge: *Provided, however,* That no part of said amount shall be so expended until the United States shall have completed the improvement of Dorchester Bay and the Neponset River to a point at the aforesaid Neponset highway bridge.

To June 30, 1907, no expenditure had been made. The maximum draft that can be carried at mean low water over the shoalest part of the channel to be improved is 13 feet to Commercial Point, and 8 feet to Neponset highway bridge. The mean range of tides is 9.6 feet.

During the calendar year 1906 the total commerce of the bay and river was 334,026 tons, of which 36,622 tons was carried to Milton above the limits of the improvement undertaken by the United States.

The purpose of the improvement is to permit the delivery at the localities concerned of freight, principally coal, at the lowest freight rates, by providing a depth of water necessary to accommodate ocean-going barges.

The head of navigation is at Milton Mills, to which point 4 miles above the mouth of the river the stream is navigable in fact.

The project for the improvement of the bay and river, with report and map of survey, is published in House Document No. 83, Fifty-ninth Congress, second session. The report of an examination of this river made in 1892 is printed in the Annual Report of the Chief of Engineers for 1893, page 800; and the report of an examination and survey in 1897, in the Annual Report for 1897, page 876.

Amount appropriated by river and harbor act approved March 2, 1907-----	\$125,233.00
July 1, 1907, balance unexpended-----	125,233.00

(See Appendix B 11.)

12. *Weymouth and Town rivers, Massachusetts.*—(a) *Weymouth Fore River (below Weymouth Fore River bridge).*—The improvement embraces only that portion of the river extending from its mouth in Hingham Bay about  $3\frac{1}{2}$  miles up to Weymouth Fore River bridge, at Quincy Point, about 1,000 feet above its confluence with Town River.

In its original condition the channel had a depth of 18 feet at mean low water with a least width of 300 feet up to a point about 1 mile below the bridge aforesaid, the 18-foot channel extending 3,400 feet above that point, but too tortuous for safe navigation of large vessels. In the remaining 1,800 feet to the bridge the channel, when surveyed, was 150 feet wide and 13 feet deep at mean low water, but, before the adoption of the project, had been increased without expense to the United States to the width of 200 feet and depth of 15 feet at mean low water.

The existing project, adopted by the act of March 3, 1905, is to dredge a channel 300 feet wide and 18 feet deep from the termination of the natural 18-foot channel to the Weymouth Fore River bridge, a distance of about 1 mile, at an estimated cost of \$57,500.

The act of March 3, 1905, appropriated the full amount of the estimate with the proviso:

That no part of this sum shall be expended until the Secretary of War shall have received satisfactory assurance that the improvement of that portion of the Weymouth River which lies above the improvement herein mentioned, and of the Town River, except so much as is herein provided for, shall hereafter be maintained by the State of Massachusetts, or other agency, without expense to the Government of the United States.

By a resolution of the legislature, approved by the governor May 26, this assurance was given by the Commonwealth of Massachusetts and accepted by the Secretary of War June 7, 1905.

The amount expended on this project to June 30, 1907, not including outstanding liabilities, is \$51,486.90, all for improvement, with which the channel has been dredged to the dimensions authorized by the project.

The maximum draft that can be carried through the portion of the river embraced in this improvement is 18 feet at mean low water. The mean range of tides is 9.5 feet.

The head of navigation is 2.7 miles above this improvement at East Braintree, to which latter point the navigable length of Weymouth River from its mouth in Hingham Bay is 6.2 miles.

During the calendar year 1904 the total commerce on the river amounted to 95,843 tons and in 1906 to 124,388 tons, of which more than 93 per cent was coal. The effect of the completion of the present project upon freight rates can not yet be determined.

The improvement is of importance chiefly to the Fore River Ship Building Company, which builds at its extensive plant at Quincy Point large passenger and freight steamers, cruisers, and battle ships up to 20,000 tons.

A report of the survey of Weymouth Fore River is in the Report of the Chief of Engineers for 1904, pages 891-898.

July 1, 1906, balance unexpended.....	\$26, 208. 85
June 30, 1907, amount expended during fiscal year, for works of improvement.....	20, 195. 75
July 1, 1907, balance unexpended.....	6, 013. 10
July 1, 1907, outstanding liabilities.....	1, 614. 51
July 1, 1907, balance available.....	4, 398. 50

(b) *Weymouth Fore River (above Weymouth Fore River bridge).*—In its original condition Weymouth Fore River had a navigable channel 13 to 18 feet deep at mean low water from its mouth, in Hingham Bay,  $3\frac{1}{2}$  miles to Weymouth Fore River bridge, and for 2,200 feet above that bridge the depth at mean low water was 12 feet; 4,000 feet farther the depth was 6 feet in a channel of practicable width; and 7,000 feet farther it was 3 feet, but the channel was too narrow to be practicable.

The original project, adopted by the act of September 19, 1890, which is also the existing project, is to obtain in Weymouth Fore River a navigable channel 6 feet deep at mean low water for the farther distance of 7,000 feet, 100 feet wide for 4,400 feet to near Weymouth Landing, 80 feet wide thence 1,650 feet to Braintree bridge, and 50 feet wide thence 950 feet above that point, at an estimated cost of \$40,000.

The amount expended on this project is \$42,750, including \$2,750 for maintenance. With this expenditure, except for 4 small ledges uncovered by dredging, there has been dredged and maintained to this time a channel of the full projected dimensions, the future maintenance of which devolves upon the State of Massachusetts pursuant to the acts of Congress and the legislature of Massachusetts, printed on pages 824 and 825, Annual Report, Chief of Engineers, for 1905.

The maximum draft that can be carried at mean low water over the shoalest part of the locality under improvement is 6 feet. The mean range of tides is 9.4 feet.

The head of navigation is the dam at East Braintree, the upper limit of that part of the channel under improvement, to which point, 2.9 miles above its confluence with Town River, the stream is navigable in fact.

The commerce of the entire river amounted in 1906 to 124,388 tons, of which more than 93 per cent was coal.

The project for improvement, with report of survey, is printed in the Annual Report of the Chief of Engineers for 1890, page 522.

(c) *Weymouth Back River.*—In its original condition Weymouth Back River had a practicable channel not less than 200 feet wide and not less than 12 feet deep at mean low water from its confluence with Weymouth Fore River, 8,000 feet to the wharf of the American Agricultural Chemical Company, except on its bar, 400 feet across, one-fourth of a mile above its mouth, where the depth was 11 feet, and except the 2,000 feet next below that wharf, where the depth gradually shoaled from 12 feet to 6 feet at mean low water.

The original project adopted by a proviso in the act of August 18, 1894, which is also the existing project, is to dredge in Weymouth Back River a channel 12 feet deep at mean low water 200 feet wide through the bar and to extend the channel 12 feet deep at mean low water and 200 feet wide 2,200 feet to the wharf of the American Agricultural Chemical Company, at an estimated cost of \$22,000.

The amount expended on this project to June 30, 1907, is \$11,857.88, all for improvement, with which 400 feet of the channel on the bar has been dredged to the full width and depth prescribed in the project, and the 2,000 feet of channel extending to the American Agricultural Chemical Company's wharf to the depth of 12 feet at mean low water and the width of 125 feet.

The available funds will be applied to the completion of the improvement.

The maximum draft that can be carried, June 30, 1907, at mean low water over the shoalest part of the locality under improvement is 12 feet. The mean range of tides is 9.4 feet.

The head of navigation is about 4 miles above the bar at the mouth of the river, and about 3 miles above the wharf of the Chemical Company, which is the upper limit of the improvement.

The commerce benefited by the improvement comprised, in 1904, 124,691 tons, in 1905, 145,933 tons, and in 1906, 136,560 tons, of which about three-fourths was raw and manufactured fertilizer products.

A report of the survey of Weymouth Back River is printed in the Annual Report of the Chief of Engineers for 1891, page 683.

July 1, 1906, balance unexpended.....	\$746. 41
Amount appropriated by river and harbor act approved March 2, 1907.....	9, 500. 00
	<hr/>
	10, 246. 41
June 30, 1907, amount expended during fiscal year, for works of improvement .....	104. 29
	<hr/>
July 1, 1907, balance unexpended.....	10, 142. 12
July 1, 1907, outstanding liabilities.....	97. 45
	<hr/>
July 1, 1907, balance available.....	10, 044. 67

(d) *Town River, Massachusetts.*—In its original condition Town River had a good channel, not less than 7 feet deep at mean low water, extending 4,000 feet from its confluence with Weymouth Fore River.

At that distance the channel suddenly shoaled to less than 4 feet, and was 1 to 2 feet deep for a distance of 3,300 feet, and was about 18 inches above low water for a farther distance of about 1,200 feet to the upper wharves at Quincy.

The original project adopted by the river and harbor act of June 3, 1896, which is the present project, is to dredge the channel 4,500 feet long, to the upper wharves at Quincy, to the width of 100 feet and depth of 4 feet at mean low water, at a cost, estimated March 24, 1897, of \$25,000.

To June 30, 1907, the amount expended is \$37,577.41, including \$12,577.41 for maintenance. With this expenditure there has been dredged and maintained to this time a channel of the full projected dimensions, the future maintenance of which devolves upon the State of Massachusetts, pursuant to the acts of Congress and the



legislature of Massachusetts, printed on pages 824 and 825. Report of the Chief of Engineers for 1905.

The maximum draft that can be carried, on June 30, 1907, at mean low water throughout the improved channel is 4 feet. The mean range of tides is 9.4 feet.

The head of navigation is at the upper limit of the improvement, at Quincy, Mass., to which point, about  $1\frac{1}{2}$  miles above the confluence with the Weymouth Fore River, the stream is navigable in fact.

The annual commerce of Town River amounted in 1902 to 99,373 tons, in 1904 to 43,976 tons, and in 1906 to 22,126 tons.

The original project, with report of survey, is printed in the Annual Report of the Chief of Engineers for 1891, page 679.

#### CONSOLIDATED.

July 1, 1906, balance unexpended.....	\$26,955. 26
Amount appropriated by river and harbor act approved March 2, 1907 .....	9,500. 00
	<hr/> 36,455. 26
June 30, 1907, amount expended during fiscal year, for works of improvement .....	20,300. 04
	<hr/>
July 1, 1907, balance unexpended.....	16,155. 22
July 1, 1907, outstanding liabilities.....	1,711. 96
	<hr/>
July 1, 1907, balance available.....	14,443. 26
(See Appendix B 12.)	

13. *Hingham Harbor, Massachusetts.*—In its original condition the channel leading to Hingham, south of Ragged and Sailor islands, was very narrow and crooked and obstructed by sunken rocks and shoals, over which the least depth was 4 feet at mean low water, while the available width of channel was but 30 feet.

The original project, adopted by the act of March 3, 1875, was to widen and deepen the natural channel by dredging and blasting to the width of 100 feet and depth of 8 feet at mean low water from deep water near the head of the harbor to the steamboat wharf, a distance of about 2,500 feet, at an estimated cost of \$11,000. This improvement was completed in 1884, with the expenditure of \$9,316.58, all for improvement, allotted from the appropriation for improving harbor at Boston, Mass.

The existing project, adopted by the act of August 5, 1886, and completed in 1893, is to deepen the improved channel 100 feet wide to 10 feet at mean low water and remove a mid-channel ledge, in the lower channel between Chandlers and Ragged islands, at an estimated cost of \$18,750. By the act of March 2, 1907, without previous estimate, \$10,000 was appropriated for redredging the channel.

To June 30, 1907, \$19,319.02 (including \$319.02 for maintenance) has been expended under the existing project.

The maximum draft that can be carried June 30, 1907, over the shoalest part of the locality under improvement is  $8\frac{1}{2}$  feet at mean low water. The mean range of tides is 9.5 feet.

The commerce benefited by the improvement consists of coal and building materials, of which 15,210 tons was received during the calendar year 1906, slightly less than the freight reported received

in 1883; but the line of Boston passenger steamers which at the time the improvement was made landed at the pier at the head of the improved channel has long since been discontinued.

The original project, with survey of the harbor, is in the Annual Report, Chief of Engineers, for 1875, Part 2, page 417. A report of the survey upon which the present project is based is in the Annual Report for 1885, page 555, and a map of the harbor in the report for 1888, page 456.

Amount appropriated by river and harbor act approved March 2, 1907.	\$10,000.00
June 30, 1907, amount expended during fiscal year, for maintenance of improvement	319.02

July 1, 1907, balance unexpended	9,680.98
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(See Appendix B 13.)

14. *Harbor at Scituate, Mass.*—In its original condition the depth on the bar was about 2.5 feet at mean low water, and the entrance was obstructed by many sunken bowlders; of the low-water area of about 57 acres, 6 acres had a depth of at least 3 feet at mean low water and there was little protection against the sea.

The original project seems to have been to protect the beach between Cedar Point and the mainland on the northerly side of the entrance to the harbor, upon which, prior to operations under the existing project (in 1829 to 1852), \$1,090.98 was expended in building 450 linear feet of brush and stone bulkhead and 385 linear feet of stone apron 10 feet wide.

The existing project, adopted by the act of June 14, 1880, is to build, of rubblestone, a north breakwater 800 feet and a south breakwater 730 feet long, to dredge an anchorage basin of 30 acres and an entrance channel 2,700 feet long and 300 feet wide, with depths at mean low water of 15 feet at the entrance, 12 to 15 feet between the breakwaters, 12 feet immediately back of the south breakwater, 10 feet in the anchorage basin, and 3 feet in the channel to the wharves, at an estimated cost of \$100,000 for the breakwaters and of \$190,000 for the dredging; total, \$290,000.

Up to the close of the fiscal year ending June 30, 1907, there had been expended on the work under the existing project \$103,500, of which \$1,989.11 was expended for maintenance in 1900 and 1901. The amount previously expended for maintenance is not ascertainable.

With that expenditure all known bowlders obstructing the entrance to the harbor have been removed; the anchorage basin, 350 feet by 400 feet, has been dredged 7 feet at mean low water, and the channel from the sea to the basin has been dredged 7 feet deep, 100 feet wide, and 1,600 feet long; the channel, 2,150 feet long from the anchorage basin to the town wharves has been dredged 3 feet at mean low water at least 100 feet wide; and 720 linear feet of the north breakwater and 450 linear feet of the south breakwater have been built.

Fifty per cent of breakwater construction and 21 per cent of the dredging authorized have been completed.

The maximum draft that can be carried at mean low water, June 30, 1907, over the shoalest part of the locality under improvement is through the entrance channel and basin 7 feet and through the channel from the basin to the town wharves 26 inches at mean low water. The mean range of tides is 9.8 feet.

In pursuance of a resolution of the Committee on Rivers and Harbors of the House of Representatives, the Board of Engineers for Rivers and Harbors has considered the project for this work, and in its report, published in Annual Report of the Chief of Engineers for 1903, pages 777-780, concurs in the opinion of the district officer that this place is not worthy of further improvement as a harbor of refuge, but in order to realize the greatest advantage from work already done, recommends the discontinuance of the present project for the improvement of Scituate Harbor and the adoption of a project for obtaining a channel 6 feet deep at mean low water and 100 feet wide from the entrance to the docks, at the cost of \$18,000.

The improvement of the channel has admitted to the wharves barges carrying 700 to 800 tons of coal each, in place of schooners carrying 150 to 200 tons, and is reported to have reduced freight rates 50 to 75 cents a ton, which it is reported would be further reduced about 25 cents a ton if the channel be deepened to 6 feet, as recommended.

The commerce benefited by this improvement consists of coal and building materials, of which 8,623 tons was received in 1903 and 8,197 tons in 1906.

The existing project, as reported by a Board of Engineers, September 18, 1880, with map of the harbor, is published in Annual Report of the Chief of Engineers for 1881, page 523.

Amount (estimated) required for completion of existing project--- \$186,500.00

(See Appendix B 14.)

15. *Harbor at Duxbury, Mass.*—This harbor has two channels leading from deep water in the "Cow Yard" in Plymouth Harbor. The easterly channel to the east of Captains Hill is in Duxbury Bay, an extensive area of sandy shoals separated from the ocean by Duxbury Beach, a slender beach about  $4\frac{1}{2}$  miles in length; the westerly channel, known as the Miles channel, leads into Kingston Bay, west of Captains Hill.

In its original condition the easterly channel had a practicable width with a depth of 6 feet at mean low water to a point 2,600 feet from the wharf at Duxbury, in Duxbury Bay, and the Miles channel a depth of 8 feet at mean low water and a practicable width to a point 2,100 feet from the wharf at Duxbury, in Kingston Bay.

The original projects appear to have been—

1. For the protection of the beach, authorized by the act of July 4, 1836, by building groins of stakes and brush.

2. For the improvement of the channel, authorized by the act of June 10, 1872, to extend the Miles channel by dredging to the depth of 8 feet and width of 200 feet for a distance of 2,300 feet up to a point 200 feet above the wharf at Duxbury, in Kingston Bay.

On these projects there was expended prior to operations under existing project \$25,000, with which some protection was given to Duxbury Beach, and the Miles channel was extended the aforesaid distance with the aforesaid depth and width.

The existing project, approved by the Secretary of War August 12, 1899 (a modification of a project submitted November 28, 1887), is to dredge a channel 6 feet deep at mean low water 60 feet wide, increasing to 100 feet on the curve, from the southerly wharf at Dux-

bury, in Duxbury Bay, 3,600 feet to the head of the easterly channel, at an estimated cost (as increased in 1899) of \$17,820.

To the close of the fiscal year ending June 30, 1907, there had been expended under the existing project \$12,000, all for improvement. With this expenditure the easterly channel has been extended with the depth of 6 feet the entire distance of 3,600 feet to the wharf, with a width of 80 feet at the wharf, 60 feet at the turn, and 40 feet elsewhere. The project is 81 per cent completed.

The maximum draft that can be carried over the shoalest part of the improvement at mean low water June 30, 1907, is 2 feet. The mean range of tides is 9.3 feet.

The commerce, consisting of coal and lumber, amounted in 1904 to 1,494 tons, in 1905 to 2,948 tons, and in 1906 to 3,949 tons.

The project for beach protection, adopted in 1836, is in the Annual Report of the Chief of Engineers for 1866, Part 2, page 36.

The original project for improving the harbor is in Annual Report of the Chief of Engineers for 1872, pages 947 and 964.

The existing project (without modifications approved August 12, 1899) is in Annual Report of the Chief of Engineers for 1888, page 473, together with maps of the harbor. No map or description of the channel as modified under the project of 1899 has been published.

Amount (estimated) required for completion of existing project---- \$5,820.00  
(See Appendix B 15.)

16. *Harbors of Plymouth and Provincetown, Mass.*—(a) *Harbor at Plymouth.*—In the original condition of the harbor the channel and low-water line were about 2,500 feet from the wharf at Plymouth. Long Beach, between the harbor and the ocean, was, for the most part, low and narrow, and liable to inroads by the sea that would injure or destroy the harbor.

All projects and expenditures prior to 1875 appear to have been for the construction of works for the preservation of the beach.

The original project for the improvement of the channel, adopted by the act of March 3, 1875, was to dredge a channel, 100 feet wide and 6 feet deep at mean low water, through the flats from the channel in the inner harbor to Long Wharf in Plymouth, at an estimated cost of \$28,000.

Prior to operations under the existing project, \$198,859.22 had been expended in preserving Long Beach and in dredging under the project of March 3, 1875, as modified, which resulted in obtaining a channel 150 feet wide and 9 feet deep and a basin directly in front of the town wharves 866 feet long, 150 feet wide, and 9 feet deep. Of this amount \$60,727.52 was expended for maintenance.

The existing project for the protection of the beach, adopted by the act of March 3, 1899, is to strengthen the sections of beach damaged by the great storm of November, 1898, and to restore Eel River to its former course, discharging into the head of the harbor, from its course into the sea, to which it was changed by the storm. The estimated cost was \$95,700.

The amount expended on the work of improvement under the existing project to the close of the fiscal year ending June 30, 1907, is \$73,437.28, with which 11,843 linear feet of rubblestone dike was built on Long Beach, which has resulted in strengthening the beach

by the accretion of a large volume of sand and beach shingle; Eel River was restored to its former course, and 536 linear feet of stone dike was built to prevent the river from being again turned into the sea. In addition to the aforesaid amount expended under the present project, \$3,954.42 has been expended for maintenance in redredging the turning basin, which had been dredged at the wharves under the project of March 3, 1875.

By way of refundment, \$4,530.12 was collected as damages from the surety of a failing contractor.

In the report of January 20, 1899, submitting the project with estimate of cost, it was said:

The following estimate for this work should be considered approximate only, for the reason that further changes are likely to occur before the work can be accomplished, which changes may materially increase or diminish the amount of work necessary to restore the beach to a safe condition.

The accretion of the beach before the stone dike was built materially diminished the cross section of a considerable part of it, and permitted its extension to protect other places where further erosion has occurred.

It is proposed to apply the available balance to repairing the riprap dike on the beach.

The commerce consists of coal, lumber, and stone, of which 24,765 tons was received in 1899 and 33,354 tons in 1906.

It is reported by the harbor master at Plymouth that the improvement of this locality by the United States has effected a saving of 50 cents per ton in freight rates.

The maximum draft that can be carried, June 30, 1907, at mean low water, over the shoalest part of the locality under improvement is 7.5 feet. The mean range of tides is 10.1 feet.

The original project for dredging is published in the Annual Report of the Chief of Engineers for 1874, Part 2, page 348. The project of 1899 is printed in the report for that year, page 1089. A map of the dredged channel and basin is printed in the Annual Report of the Chief of Engineers for 1888, page 460.

July 1, 1906, balance unexpended.....	\$3, 802. 53
Damages from surety of failing contractor.....	4, 530. 12
	<hr/>
	8, 332. 65
June 30, 1907, amount expended during fiscal year, for works of improvement.....	61. 71
	<hr/>
July 1, 1907, balance unexpended.....	8, 270. 94
	<hr/>
Amount (estimated) required for completion of existing project.....	20, 700. 00

(b) *Harbor at Provincetown, Mass.*—This is an important harbor of refuge in the bight at the extremity of Cape Cod.

In its original condition the width and depth of its entrance and the depth of its anchorage were ample for the largest vessels, but actual or threatened inroads by the sea across the low and narrow part of the cape east of the town, and at intervals along about 1½ miles of the narrow beach southwest of the town, were a serious menace to the harbor.

The original project, adopted by the act of May 20, 1826, was "for the preservation of the point of land forming Provincetown Harbor."

The project from 1826 continuously to this date has been, by building dikes and groins and by other sand-catching devices, to arrest the erosion and promote the accretion of the barrier of beach and sand dunes which protects and preserves the harbor.

The amount expended to June 30, 1907, is \$215,399.85, all applied to improvement.

The result of the expenditure has been the preservation of the barrier of beach and sand dunes essential to the preservation of the harbor.

The maximum draft that can be carried to the anchorage is ample for the largest vessels.

The balance available will be applied to works of protection for preserving and strengthening the beach that preserves the harbor.

A description and plan of works are in the Annual Reports of the Chief of Engineers for 1876, 1879, and 1886, pages 181, 273, and 574, respectively.

A special project for the protection of the most slender part of the beach southwesterly of Provincetown is published in Annual Report of the Chief of Engineers for 1897, page 878.

The commerce of this port, amounting in 1906 to about 20,900 tons, is a small factor in this improvement compared with the preservation of this very excellent and important harbor of refuge.

July 1, 1906, balance unexpended.....	\$6, 571. 64
Amount appropriated by river and harbor act approved March 2, 1907.....	5, 000. 00
	<hr/> 11, 571. 64
June 30, 1907, amount expended during fiscal year, for works of improvement.....	1, 143. 05
July 1, 1907, balance unexpended.....	<hr/> 10, 428. 59

## CONSOLIDATED.

July 1, 1906, balance unexpended.....	\$10, 374. 17
Damages from surety of failing contractor.....	4, 530. 12
Amount appropriated by river and harbor act approved March 2, 1907.....	5, 000. 00
	<hr/> 19, 904. 29
June 30, 1907, amount expended during fiscal year, for works of improvement.....	1, 204. 76
July 1, 1907, balance unexpended.....	<hr/> 18, 699. 53
Amount (estimated) required for completion of existing project....	16, 169. 88
(See Appendix B 16.)	

17. *Channel between North and South Hero islands, Lake Champlain, Vermont.*—By the original project, adopted by the act of July 4, 1836, this channel, sometimes called the "Gut," was deepened by dredging to 8 feet at mean low water. The work was completed in 1839, at a total expense of \$21,000.

In 1881 it was found by survey that the channel, about  $1\frac{1}{2}$  miles long, had an average depth of  $10\frac{1}{2}$  feet, with sufficient width, except that it was obstructed at its western entrance by a bar through which the channel was 40 feet wide and 7 feet deep, and at its eastern entrance by a bar through which the channel was 100 feet wide and 8 feet deep.

The existing project, adopted by the act of August 11, 1888, is to obtain a channel 150 feet wide and 10 feet deep at both entrances, at an estimated cost of \$14,300. The dredging was done in 1889 and the channel reported as completed.

Since 1897 it has been reported that the western entrance to the passage was obstructed by a dangerous bowlder in mid-channel and that the channel was 1 to 4 feet shoal and 25 feet narrower than the project prescribed. A survey of the channel made in January, 1906, in connection with the complaint that the bridge of the Rutland Railroad Company is an unreasonable obstruction to navigation through the channel, shows that the channel has shoaled to the depth of approximately 7 feet at low lake level.

To June 30, 1907, the amount expended under the existing project is \$10,000, appropriated by the act of 1888.

This channel is the main water connection between the commercial channel on the western side and Swanton Harbor and St. Albans Bay on the eastern side of the lake, and is generally used by steam and sailing vessels plying in that part of the lake, but the amount of commerce benefited by the improvement can not be accurately stated. Two steamers, carrying freight and considerable numbers of passengers, each pass through this channel twice daily during the season of navigation.

The existing project, with report of survey, is published in the Annual Report of the Chief of Engineers for 1897, page 3299.

18. *Harbor at Burlington, Vt.*—Before improvement there was ample depth of water along the docks and wharves, but they were without protection against wind and seas from Lake Champlain. In the greatest exposure during the prevalent northwesterly gales the wind has a sweep obliquely across the lake of about 10 nautical miles.

The original project, adopted by the act of July 4, 1836, was to build a breakwater parallel with the shore and about 1,000 feet from the docks and wharves.

Under the original and modified projects the amount expended for construction prior to the adoption of the project of 1886 was \$501,811.07, with which 3,551 feet of breakwater was built.

The existing project, adopted in 1886, is to extend the breakwater 1,500 feet (500 feet northerly and 1,000 feet southerly), at an estimated cost of \$150,000; enlarged in 1894 and 1902 to embrace repairs and replacing the crib superstructure (4,157 feet) with one of stone or concrete, at a cost estimated at \$173,750, a total of \$323,750. Completion of repairs is authorized to be done under continuing contract. Under this authorization \$16,855 remains to be appropriated.

Under the existing project there was expended to June 30, 1907, \$183,918.82, of which \$59,738.69 was applied to extending the breakwater 606 feet (364 feet northerly and 242 feet southerly), making the total length of the structure 4,157 feet, and the sum of \$124,180.13 was applied to repairs and completing the rebuilding of 3,000 feet of superstructure; \$10 was derived from sales. The extension is 40 per cent and the rebuilding 72 per cent completed.

The extreme variation of level of water surface is  $6\frac{1}{2}$  feet and the usual variation about 4 or 5 feet.

The available funds and the appropriation asked for will be applied to repairs and maintenance in replacing the decayed timber superstructure with superstructure of stone and concrete.

The commerce amounted in 1904 to 107,421 tons, and in 1906 to 236,798 tons, of which, in 1906, 75 per cent was lumber.

A description of the existing project for repairs and maintenance may be found in the Annual Report of the Chief of Engineers for 1901, page 1072, and a description and history of the work in the Annual Report for 1897, page 3296.

July 1, 1906, balance unexpended.....	\$37, 206. 73
Receipts from sales.....	10. 00
Amount appropriated by sundry civil act approved March 4, 1907....	35, 000. 00
	<hr/> 72, 216. 73
• June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	29, 625. 55
July 1, 1907, balance unexpended.....	42, 591. 18
July 1, 1907, outstanding liabilities.....	1, 932. 61
July 1, 1907, balance available.....	<hr/> 40, 658. 57
July 1, 1907, amount covered by uncompleted contracts.....	22, 735. 52
Amount (estimated) required for completion of existing project....	<hr/> <sup>a</sup> 106, 855. 00

{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for maintenance of improvement, in addition to the balance unexpended July 1, 1907..... 10, 000. 00  
 Submitted in compliance with requirements of sundry civil act of June 4, 1897, and of section 7 of the river and harbor act of 1899.

(See Appendix B 17.)

19. *Narrows of Lake Champlain, New York and Vermont.*—In its original condition the 15 miles of this waterway extending from the northern terminus of the Champlain Canal, at Whitehall, northerly to Benson Landing, Vt., had a narrow and tortuous channel not more than 9½ feet to 10 feet deep on the shoals at low water.

The original project, adopted by the act of August 5, 1886, was to obtain, by dredging and by a small amount of rock excavation, a channel with a least width of 150 feet and depth of 12 feet at low water from Whitehall to deep water below Benson Landing, a distance of 15 miles. On the original project (as extended in 1890 to widen and straighten the middle reaches of the channel) the amount expended prior to operations under existing project was \$63,500.

The existing project, adopted by the act of March 3, 1899, is to widen the channel and restore it to the depth of 12 feet at mean low water in five localities; also to provide fenders for protecting barges from collision with the rocky banks of the channel at Puts rock, the Narrows, and Pulpit Point, at an estimated cost of \$22,500.

To June 30, 1907, the amount expended under the existing project was \$24,015, including \$15 for maintenance, with which the project has been completed. Available funds will be applied to maintenance of the improvement.

To June 30, 1907, the maximum draft that can be carried over the shoalest part of the locality under improvement is 12 feet at low

<sup>a</sup> Of this amount \$16,855 is under continuing-contract authorization.



water. The extreme variation of level of water surface is  $6\frac{1}{2}$  feet, and the usual variation about 4 or 5 feet.

From the foot of the canal at Whitehall to the head of Lake Champlain at Crown Point the navigable length of the Narrows is 37 miles. From Whitehall navigation is continued to the Hudson River and Erie Canal by the Champlain Canal, which is 65 miles long, from the southern extremity of the Narrows at Whitehall to Troy, N. Y.

The commerce consists principally of coal, pulp wood, building material, and general merchandise, and amounted in 1904 to 651,592 tons, in 1905 to 698,617 tons, and in 1906 to 676,051 tons.

The original project, with report and map of the survey of the channel, is published in the Annual Report of the Chief of Engineers for 1885, pages 2312 and 2315, and the existing project in the Annual Report for 1897, page 3302, and 1898, page 1046.

July 1, 1906, balance unexpended.....	\$2, 500. 00
Amount appropriated by river and harbor act approved March 2, 1907.....	2, 500. 00
	<hr/>
	5, 000. 00
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	15. 00
	<hr/>
July 1, 1907, balance unexpended.....	4, 985. 00
(See Appendix B 18.)	

#### EXAMINATIONS AND SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF MARCH 3, 1905.

Reports on preliminary examinations and surveys required by the river and harbor act approved March 3, 1905, of the following localities within this district were duly submitted by the district officer. They were reviewed by the Board of Engineers for Rivers and Harbors, pursuant to law, and were transmitted to Congress and printed in documents as indicated:

1. *Preliminary examination and survey of Dorchester Bay and Neponset River, Massachusetts.*—Reports dated June 3, 1905, and April 14, 1906, respectively, are printed in House Document No. 83, Fifty-ninth Congress, second session. A plan for improvement at an estimated cost of \$125,233.34 is presented.

2. *Preliminary examination and survey of Merrimac River, Massachusetts, with a view to providing a channel 12 feet deep between the mouth of the river and the falls above the city of Haverhill, etc.*—Reports dated November 22, 1905, and December 5, 1906, respectively, are printed in House Document No. 339, Fifty-ninth Congress, second session. A plan for improvement at an estimated cost of \$62,000 is presented for removing certain obstructions at the mouth of the river.

#### IMPROVEMENT OF RIVERS AND HARBORS IN SOUTHEASTERN MASSACHUSETTS AND IN RHODE ISLAND.

This district was in the charge of Lieut. Col. J. H. Willard, Corps of Engineers. Division engineer, Col. Amos Stickney, Corps of Engineers, to June 4, 1907, and Col. John G. D. Knight, Corps of Engineers, since that date.

1. *Harbors at Hyannis and Nantucket, Mass.*—(a) *Harbor of refuge at Hyannis.*—The harbor of Hyannis lies on the south shore of the peninsula of Cape Cod and about 15 miles to the westward of the heel of the cape, and is an important harbor of refuge.

This harbor before improvement was an open roadstead, exposed to southerly storms.

In the years 1827–1838 a breakwater 1,170 feet long was constructed of riprap granite, covering an anchorage of about 175 acres, the entrance to which has a depth of about 15.5 feet.

Between the years 1852 and 1882 extensive repairs were made, increasing the width of the base of the breakwater and the size of the stone forming its sides and top.

The sum of \$123,431.82 had been expended at this harbor prior to operations under existing project.

The existing project, approved in 1884, provides for dredging to 15.5 feet at low water about 36 acres area north of the existing breakwater, so as to increase the deep-water anchorage by that amount, all at a total estimated cost at that time of \$45,743.20, increased \$30,568.94 in accordance with the report of December 2, 1899, by river and harbor act of June 13, 1902, making the total estimated cost \$76,312.14.

The act of 1902 consolidated the works of Hyannis and Nantucket, appropriating therefor \$35,000, of which an allotment of \$20,000 was made for Hyannis Harbor and \$15,000 for Nantucket.

The act of 1905 appropriated \$80,000 for these two works, of which \$8,173.25 was allotted to Hyannis Harbor and \$71,826.75 to Nantucket.

At the adoption of the existing project the 15.5-foot depth anchorage covered only about 47 acres, and the 36 additional acres to be dredged carried a depth of from 7 to 15.5 feet of water at low water.

The amount expended on the existing project up to the close of the fiscal year ending June 30, 1907, exclusive of outstanding liabilities, was \$73,855.93, none of which was applied to maintenance. This expenditure completed the project and dredged two cuts each 25 feet wide and 13 feet deep at mean low water through the channel leading to the wharf of the New York, New Haven and Hartford Railroad Company.

The mean rise and fall of the tide is about 3 feet.

The principal value of this harbor to commerce is as a harbor of refuge for coasters and fishing vessels. The actual commerce of the place is, in general, agricultural products, coal, and fish, aggregating 20,100 tons. The increase of anchorage area will afford a larger refuge for more boats.

No further work is proposed.

For reference to former reports in which more extended information may be found, see Annual Report of the Chief of Engineers for 1905, page 75.

July 1, 1906, balance unexpended.....	\$2,314.45
June 30, 1907, amount expended during fiscal year, for	
works of improvement.....	\$1,287.70
Transferred to Nantucket Harbor.....	1,026.75
	<hr/> 2,314.45

(b) *Harbor of refuge at Nantucket, Mass.*—This harbor is the only one between the harbors of Marthas Vineyard (Vineyard Haven and

Edgartown) and Provincetown, a distance of 100 miles, except the small harbor of Hyannis, on the north side of Nantucket Sound. It has considerable area, with a depth of water in excess of 12 feet, and the object of the improvement is to make it a harbor of refuge for vessels plying between ports north and south of Cape Cod. Incidentally it forms a commercial harbor for the island of Nantucket, and it is the only one on the island. So far as known it has never been used to any extent as a harbor of refuge.

In its original condition the channel entrance was obstructed by a bar 1.5 miles in width, on which there was only 6 feet of water at low tide, the channel being very crooked and subject to changes in location. Between 1829 and 1844 an ineffectual attempt was made to dredge a channel through the bar; \$45,734.75 was expended prior to beginning operations under the existing project.

The present project, adopted in 1880 and modified in 1885, provides for the construction of two jetties, one on each side of the entrance, and for dredging when necessary, in order to obtain a channel depth of from 12 to 15 feet at low water. Estimated cost, \$375,000, exclusive of cost of dredging.

The amount expended on the existing project up to the close of the fiscal year ending June 30, 1907, exclusive of outstanding liabilities, was \$350,590.82, of which \$7,210 was expended in repairs to the west jetty, \$6,312.90 to the east jetty, and \$50,000 in dredging.

About 83 per cent of the west jetty and 78 per cent of the east jetty have been constructed. A channel 200 feet wide and 12 feet deep at mean low water was dredged between the jetties during the working season of 1905.

The mean rise and fall of the tide is about 3 feet.

During an unusually severe storm in December, 1896, a breach was made through the Haulover beach between the ocean and the head of the harbor. The breach still remains open, and it is believed that its influence has been to retard the deepening of the jetty channel.

The depth of water in the passage through the Haulover beach is said by the fishermen using it to be somewhat less since dredging the jetty channel. It would be a benefit to the jetty channel to have this passage closed.

A large portion of the 3,955 feet of the west jetty, built prior to 1884, has been damaged somewhat by storms and ice and, having no core of small stone, allows considerable sand to pass through it. This should be repaired so as to be as sand tight as possible and raised to its original height. It is estimated that \$30,000 will be required to complete the repairs in addition to the estimated cost of the project.

The approved project for this work contemplates building two converging jetties and the excavation by dredging of so much of the channel as may not be deepened by the tidal scour. The estimate of the approved project was \$375,000 for the jetties alone. But the height above low water was left to be determined by experience, and it will be some years before the work can be accepted as complete. Owing to the exposed situation, the character of the bottom, and the effect of ice, \$13,522.90 of the appropriation for construction is properly chargeable to maintenance, for which no special allotment was made. Dredging, which was included in the project but not in the estimate, had been postponed year by year to observe the action of the jetties, but \$50,000 for the purpose of dredging was first applied from

the appropriation of March 3, 1905. The dredged channel, now about 200 feet wide and 12 feet deep at mean low water, should be increased in width from the deep water off Brandt Point in the inner harbor to the 12-foot contour at the jetty entrance, and the estimate for completion has been increased \$50,000 for that purpose, making a total increase in the estimate of cost of \$100,000 on account of dredging.

Further work under the project will consist in raising the incomplete portions of both jetties as may be required, and widening the dredged channel, with a view to the extension and maintenance of the benefits to be derived from the improvement.

The entire commerce of Nantucket is carried on at this harbor, amounting in 1906 to about 43,291 tons. The effect of this work will be to afford a place of refuge easy of access and secure from storms for coasters and fishing vessels.

For reference to reports containing more detailed information see Annual Report of the Chief of Engineers for 1905, page 76.

July 1, 1906, balance unexpended.....	\$1,036.96
Amount appropriated by river and harbor act approved March 2, 1907.....	42,500.00
Amount received by transfer from Hyannis.....	1,026.75
	<hr/>
	44,563.71

June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$4,514.88
For maintenance of improvement.....	1,312.90
	<hr/>
	5,827.78

July 1, 1907, balance unexpended.....	38,735.93
July 1, 1907, outstanding liabilities.....	8,601.35

July 1, 1907, balance available.....	<hr/>
	30,134.58

July 1, 1907, amount covered by uncompleted contracts.....	26,085.11
Amount (estimated) required for completion of existing project....	101,312.90

## CONSOLIDATED.

July 1, 1906, balance unexpended.....	\$3,351.41
Amount appropriated by river and harbor act approved March 2, 1907.....	42,500.00
	<hr/>
	45,851.41

June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$5,802.58
For maintenance of improvement.....	1,312.90
	<hr/>
	7,115.48

July 1, 1907, balance unexpended.....	38,735.93
July 1, 1907, outstanding liabilities.....	8,601.35

July 1, 1907, balance available.....	<hr/>
	30,134.58

July 1, 1907, amount covered by uncompleted contracts.....	26,085.11
Amount (estimated) required for completion of existing project....	101,312.90

(See Appendix C 1.)

2. *Harbor at Vineyard Haven, Massachusetts.*—Vineyard Haven is a deep indentation on the northern shore of Marthas Vineyard Island, on the southern side of Vineyard Sound.

The headlands on either side of the entrance to the harbor were gradually wearing away and the adjacent parts of the harbor were shoaling. The mean range of tide is 1.7 feet.

The existing project of April 11, 1888, as modified in 1889, provides for the protection of the "Chops" (or headlands) from erosion and the intervening harbor from being filled with the eroded material, the whole to be done by means of stone sea walls and jetties built along the beach in front of the bluffs at both headlands. The total cost was estimated in 1889 at \$60,000, the whole of which has been appropriated.

The sum of \$55,387.35 had been expended on this work up to June 30, 1907, by which there had been built a series of riprap jetties and sea wall, which appear to have afforded the needed protection.

This harbor, being at present the most accessible refuge for the immense fleet of coasting vessels plying between points north and south of Cape Cod, is more extensively used than any other on the southern coast of New England. Additional work in this locality would be for the extension of benefits.

For reference to former reports giving more extended information, see Annual Report of the Chief of Engineers for 1905, page 77.

Further work at this harbor will depend upon the action taken upon the report of the Board of Engineers provided for by the river and harbor act of June 13, 1902.

Under permission granted July 10, 1905, the Commonwealth of Massachusetts constructed 700 feet in length of a breakwater, extending from northwest to southeast on the westerly side of Vineyard Haven Harbor, leaving still to be built 500 feet to complete the work.

July 1, 1906, balance unexpended.....	\$4, 612. 65
July 1, 1907, balance unexpended.....	4, 612. 65

(See Appendix C 2.)

3. *Woods Hole channel, Massachusetts.*—Woods Hole is a waterway or strait connecting Buzzards Bay and Vineyard Sound and lying near the southwestern part of Cape Cod, Massachusetts.

Before improvement in the strait the channels were crooked and obstructed by bowlders, and the velocity of the currents at certain stages of the tide was from 5 to 7 miles per hour. The site of the wharves and basins of the United States Fish Commission and Revenue-Marine Service was a submerged point of land from the shore of Great Harbor.

The original project of 1879 provided for making a channel through the bar at the entrance to Little Harbor and widening and deepening the channel through the strait. The project of 1883, extended in 1884 and 1886, provided for the construction of retaining walls on shore, a stone pier, and a wooden wharf, mainly for the use of the United States Fish Commission and incidentally for the use of other branches of the public service, all of which work had been completed prior to 1889.

The amount expended on the original and modified projects prior to beginning operations on the existing project was \$113,599.92, by which the entrance to Little Harbor had been dredged to 10 feet depth, and a direct channel 9 feet deep had been dredged through the strait, where none previously existed. The retaining walls, stone pier, and wooden wharves at the United States Fish Commission had also all been built and repaired.

The existing project, that of June 3, 1896, provides for deepening the channel through the strait to 13 feet at mean low water and widening the same to 300 feet; estimated cost, \$396,000.

The amount expended on the existing project up to the close of the fiscal year ending June 30, 1907, exclusive of outstanding liabilities, was \$123,261.27, resulting in the completion of the contract for deepening and widening the channels. Subsequent to the completion of this contract a small shoal off Mink Point, the northeastern extremity of Nonamesset Island, was developed in the final survey. The portion of this shoal lying within the lines of the "Broadway channel" forms a partial barrier to its southerly entrance and its removal is regarded as properly within the scope of the existing project. The removal of this shoal has been authorized by the Chief of Engineers. A clear passage of 13 feet depth at mean low tide now exists through the strait by both channels, but requires some widening, as stated above.

The mean rise and fall of the tide is about 4 feet at the Buzzards Bay end of the channel and 1.65 feet at the Vineyard Sound end.

The commerce of Woods Hole was about 27,875 tons for 1906, no account being kept of vessels passing through the strait.

Further work will consist in the removal of the shoal referred to above and a small amount of cleaning up in the main channel.

The price at which the contracts for this work have been let has been much less than the original estimates, and the relative proportion of the large bowlders to the smaller and lighter material less than the estimated amount based on previous work, so that the project will be completed for much less than the amount originally estimated.

For reference to reports containing more extended information see Annual Report of the Chief of Engineers for 1905, page 79.

July 1, 1906, balance unexpended.....	\$151, 167. 00
June 30, 1907, amount expended during fiscal year, for works of improvement.....	44, 428. 27
July 1, 1907, balance unexpended.....	106, 738. 73
July 1, 1907, outstanding liabilities.....	13. 30
July 1, 1907, balance available.....	106, 725. 43

(See Appendix C 3.)

4. *Harbors at New Bedford and Fairhaven, Mass.*—New Bedford Harbor is an estuary of Buzzards Bay, the Fairhaven side of the harbor being called Fairhaven Harbor. New Bedford is the port of the cities of New Bedford and Fairhaven.

Before improvement the channel had a depth of 12.5 feet at mean low water. The improvement of this harbor has been carried on under a number of distinct projects, the first being the removal of a wreck and dredging the sand bar formed by it in 1836-1839, on which \$10,000 was expended. The projects of 1874 and 1877 provided for a channel 300 feet wide and 15 feet deep at mean low water from the deep water just above Palmers Island to the wharves of New Bedford. This work was completed in 1877 at a cost of \$20,000.

This was followed after 1887 by various projects in which the controlling depth was 18 feet at mean low water and comprised channels 200 feet wide from Buzzards Bay to New Bedford, about 150 feet wide along the city wharf front above and below the New Bed-



5. *Sakonnet Harbor, Rhode Island.*—Sakonnet Point is a rocky headland on the eastern side of the mouth of Sakonnet River, and lies about 6 miles east of Newport. This point in connection with Churchs Cove forms an anchorage known as Sakonnet Harbor. Before improvement this harbor was protected from storms from the northeast, south, and southeast by the mainland, but was exposed to westerly storms. In 1827 a project was prepared for a breakwater 400 feet long at this point, and about 200 feet of this was built at that time. The project of 1899 provided for prolonging the old breakwater out to a rock nearly north of it and raising the whole to a height of 8 feet above mean low water. This project was completed in 1900 at a cost of \$25,000.

The existing project, adopted by the act of March 2, 1907, provides for the removal of a rock from the harbor to the depth of 8 feet at mean low water at an estimated cost of \$10,000. Nothing was expended on the existing project up to the close of the fiscal year ending June 30, 1907.

It is proposed to apply the available funds to the completion of the project.

For more detailed information, see Annual Reports of the Chief of Engineers for 1889, page 649; 1895, page 749; 1897, page 935; 1901, page 1126, and for the report on preliminary examination and survey upon which the existing project is based, page 1148 of the same report for 1901.

Amount appropriated by river and harbor act approved March 2,

1907 .....	\$10,000. 00
July 1, 1907, balance unexpended .....	10,000. 00

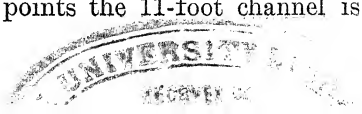
(See Appendix C 5.)

6. *Taunton River, Massachusetts.*—This river rises in Norfolk County, Mass., and empties into Mount Hope Bay at Fall River.

In its original condition the channel was narrow and obstructed by boulders, and from Berkley bridge to Taunton the depth was in places not more than 5 feet at mean high water. A vessel of 30 tons burden was as large as could go up to Taunton. From 1870 to 1879 \$63,000 was appropriated to secure 9 feet depth at high water. This work was completed in 1879.

The existing project, adopted July 14, 1880, provides for the widening and deepening of the river so as to secure a channel of at least 12 feet depth at high water, with 100 feet width from its mouth up to Berkley bridge (above Dighton); thence 12 feet depth with 80 feet width (100 feet width at bends) up to Briggs shoal; thence 11 feet depth with 80 feet width up to the "shipyard;" thence with 11 feet depth with 60 feet width up to Weir bridge, Taunton; all at a total cost estimated in 1893 at \$125,000, all of which has been appropriated.

The amount expended on the existing project up to June 30, 1907, exclusive of outstanding liabilities, was \$130,000, by which all projected work had been practically completed and the shoals offering the greatest obstruction to the navigation of the river had been redredged. About \$24,000 of the above amount has been expended in the maintenance of the channel. Vessels of 11 feet draft can reach Taunton at high water, but at some points the 11-foot channel is





very narrow. It is estimated that \$5,000 every four years will be required to maintain the channel.

The head of navigation is at Weir bridge. No portion of the river has been improved above this point.

The mean range of the tide is about 5½ feet at Dighton and 3.4 feet at Taunton.

The \$5,000 appropriated by the river and harbor act of March 3, 1905, will be applied to dredging portions of the channel which have shoaled since the original dredging, as soon as the amount of shoaling appears to interfere with the safe navigation of the river.

The tonnage of 1906 was about 193,100 tons.

Further work on this river will be for the maintenance of benefits secured by the improvement.

For reference to reports giving more extended information, see Annual Report of the Chief of Engineers for 1905, page 82.

July 1, 1906, balance unexpended.....	\$5,000.00
July 1, 1907, balance unexpended.....	5,000.00

(See Appendix C 6.)

7. *Sakonnet River, Rhode Island.*—Sakonnet River is an arm of the sea between the island of Rhode Island and the mainland, extending from the ocean to Mount Hope Bay, around the head of Rhode Island. Before improvement it was obstructed at its upper end by a causeway, known as the "Stone Bridge," extending across it. This causeway had two openings, one covered by a draw which was of insufficient width and depth for the needs of commerce, but the causeway offered such obstruction to the ebb and flow of the tides that the currents through the openings made the passage dangerous even to boats of such dimensions as could pass through them under ordinary circumstances.

The existing project, adopted June 3, 1896, provides for increasing the width and depth of the draw opening in the Stone Bridge, owned by the State of Rhode Island, so as to provide an opening 100 feet wide and 25 feet deep at mean low water, estimated to cost \$40,000.

No work had been done and no funds expended prior to May, 1905, when preliminary steps were taken and a project for the expenditure of the funds, with specifications for the work, was approved.

The long delay in the execution of this work was owing to the fact that the proposed work involved the total destruction of the existing bridge and highway, while no provision was made for rebuilding the bridge or restoring the highway. Until the State of Rhode Island granted the Federal Government the unconditional right to proceed with the work authorized by Congress and provided either for the restoration or the discontinuance of the bridge and highway, the Secretary of War could not proceed with the work. The authorities of the State had repeatedly been advised of the existing complications and of the importance of having the legislature take the proper action to remove them.

The necessary legislative action having been taken and a board of State commissioners having commenced the reconstruction of the approaches to the bridge, all obstacles to the execution of the project were removed.

The amount expended on the existing project up to June 30, 1907, exclusive of outstanding liabilities, was \$36,939.57, by which the work of enlarging the draw opening was completed.

While the passage of this point is greatly improved by the increased depth and width, the velocity of the current has not been materially reduced. The new drawbridge, which is to be of the bascule type, is not yet completed.

No further work is contemplated under the approved project.

July 1, 1906, balance unexpended.....	\$4,406.91
June 30, 1907, amount expended during fiscal year, for works of improvement.....	1,346.48

July 1, 1907, balance unexpended.....	3,060.43
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(See Appendix C 7.)

8. *Pawtucket (Seekonk) River, Rhode Island.*—This river is the upper portion of the Providence River, the navigable portion extending from Pawtucket to Providence, a distance of 4 miles. Before improvement the channel in the river was narrow and had a ruling depth of about 5 feet at mean low water. Between 1867 and 1873 \$52,000 was appropriated to dredge the channel to 7 feet depth. This work was finished in 1876. The project of July 5, 1884, provided for deepening the river so as to secure a channel of at least 12 feet depth at low water with 100 feet width from its mouth, at Providence, up to Grant & Co.'s wharf at Pawtucket, and thence 12 feet depth with 40 feet width, through a ledge rock for a short distance farther, to Pawtucket bridge, the head of navigation, all at a total cost estimated in 1883 at \$382,500, of which \$284,000 has been appropriated.

The river and harbor act of March 3, 1899, modified this project so as to provide for straightening that portion of the channel between Tennile River and Bucklins Island. The project, with its modification, has been completed, with an expenditure of \$282,444.91. This gave the channel 12 feet depth, but at a few points it has slightly shoaled and needs a small amount of dredging to restore the original depth.

The existing project, adopted by the river and harbor act of March 3, 1905, provides for deepening the channel to 16 feet at mean low water with 100 feet width and a channel through the ledge rock at Pawtucket of 16 feet depth at mean low water and 50 feet wide, at an estimated cost of \$237,875.

The amount expended on the existing project up to June 30, 1907, was \$307,984.16, by which a channel 16 feet deep was excavated through the ledge rock for a length of about 200 feet.

The approved project for the expenditure of the appropriation of \$30,000 of March 3, 1905, provided for the application of \$25,000 to the excavation of a portion of the channel through the ledge rock and of \$5,000 to deepening the points which had shoaled in the 12-foot channel.

The river and harbor act of March 2, 1907, contains the following item:

Improving Pawtucket River, Rhode Island: Completing improvement, one hundred and thirty-five thousand five hundred and eighty-four dollars: *Provided*, That no part of this sum shall be expended unless the further amount of sixty-seven thousand seven hundred and ninety-two dollars shall be provided by the

State of Rhode Island or other agency, and made subject to the order of the Secretary of War in such manner as he may direct, to be expended under his direction upon said project for its completion.

The general assembly of the State of Rhode Island passed an act making this appropriation, but—

*Provided*, That requisition for one-half of said sum shall be made on or after the first day of July, A. D. 1908, and requisition for the remainder of said sum shall be made on or after the first day of July, A. D. 1909, by said Secretary of War.

The mean rise and fall of the tide is about 5 feet.

The effect of the work thus far done on the new project is to facilitate the handling of vessels in Pawtucket Harbor, but the full benefit of the 16-foot channel will not be experienced until the project is completed.

The full capacity of the 12 feet depth of channel was utilized immediately on its completion and the demand for deeper water is now made in order that cargoes of coal coming from southern ports and carried only in the deeper-draft barges may be taken to Pawtucket without the expense of lightering at Providence.

For reference to report containing more extended information, see Annual Report of the Chief of Engineers for 1905, page 84. Reference to report on preliminary examination ordered by the river and harbor act of March 3, 1905, will be found on page 92 of the report for 1906.

July 1, 1906, balance unexpended.....	\$20, 150. 16
Amount appropriated by river and harbor act approved March 2, 1907.....	135, 584. 00
	<hr/> 155, 734. 16
June 30, 1907, amount expended during fiscal year, for works of improvement.....	14, 114. 73
	<hr/> 141, 619. 43
July 1, 1907, balance unexpended.....	

(See Appendix C 8.)

*9. Providence River and Harbor and Narragansett Bay, and Green Jacket shoal, Rhode Island.*—(a) *Providence River and Harbor and Narragansett Bay.*—The object of this improvement is to furnish a wide and deep channel for foreign and coastwise commerce from the ocean to Providence and to provide a deep-water anchorage for that harbor.

Before the improvement of the river in 1853 the available low-water depth was limited to 4.5 feet. Between 1852 and 1873, \$59,000 was expended in securing first 9 feet and then 12 feet depth of channel.

The approved project of 1878, as modified in 1882, provided for deepening the river and deepening and widening its anchorage basins so as to secure a channel of at least 25 feet depth at low water with 300 feet width from the deep water of Narragansett Bay up to Providence, R. I., and so as to secure anchorage basins of 20 feet depth with 600 feet width, 18 feet depth with 725 feet width, 12 feet depth with 940 feet width, and 6 feet depth with 1,060 feet width from Fox Point to Fields Point, all at a total cost estimated in 1882 at \$675,000. This project was completed in 1895.

Another project originated in the river and harbor act of June 3, 1896, providing for securing a ship channel 400 feet in width and of a

depth of 25 feet at mean low water from Sassafra Point, in Providence Harbor, through Providence River and Narragansett Bay by the most direct route practicable to the ocean by way of the "Western Passage," so called, at an estimated cost of \$732,820. This project was put under the continuing-contract system and the amount expended on the work up to the close of the fiscal year ending June 30, 1907, exclusive of outstanding liabilities, was \$475,232.66, by which the channel 400 feet wide and 25 feet deep had been completed from Sassafra Point to the deep water of Narragansett Bay by the Western Passage.

Under date of June 11, 1904, the Chief of Engineers authorized the use of \$2,000 of the balance remaining on hand of the appropriation for securing a channel through the Western Passage of Narragansett Bay for the removal of certain obstructing rocks in Dutch Island Harbor, Rhode Island.

The total amount expended on projects previous to the existing project was \$1,277,973.25.

The existing project, adopted by the river and harbor act of June 13, 1902, provides for an enlarged anchorage area of 25 feet depth, extending the full width of the harbor from Fox Point on the north and Long Bed and Sassafra Point on the south, including the area known as Green Jacket shoal, at an estimated cost of \$607,778. This project was enlarged by the river and harbor act of March 2, 1907, so as to include an area of uniform width to the eastward of the main ship channel between Long Bed and Kettle Point, which is to be dredged to a depth of 25 feet at mean low water, for which \$90,750 was appropriated, making the total estimated cost \$698,528.

The river and harbor act of March 3, 1905, placed this work under the continuing-contract system, and a contract for the work has been entered into for dredging all the soft material from the projected anchorage area. The removal of a small amount of hard material in the southeast corner of the area is to form the subject of another contract after the overlying soft material has been removed.

The amount expended on the existing project up to the close of the fiscal year ending June 30, 1907, was \$423,656.48, by which the soft material had been dredged from about 95 per cent of the entire area of the original existing project, leaving still to be dredged a small triangular area in the extreme southeast corner of Green Jacket shoal, a small area adjacent to the harbor line on the easterly side of the harbor below Wilkesbarre Pier, and the hard material from the portion of Long Bed covered by the existing project.

Further work under this project will extend the benefits secured thus far.

It is proposed to apply the existing balance to the completion of the existing project.

The improvement in general has been of great benefit to commerce, which in 1906 amounted to \$3,086,003. No special benefit is apparent from the dredging in the Western Passage, which has shortened the channel a little for a part of the commerce of Providence.

For reference to reports containing more extended information, see Annual Report of the Chief of Engineers for 1905, page 85.

(b) *Green Jacket shoal*.—This shoal was in that part of Providence River which constitutes the harbor of Providence. It lay off the wharves on the south front of the city and occupied a part of the harbor that is required for anchorage purposes, covering an area of about 18 acres between the 15-foot curves and about 30 acres in all.

In its original condition the shoal in many places carried only 1 foot of water and was a very troublesome obstruction.

The project for the removal of this shoal was adopted August 5, 1886.

The sum of \$104,250 was expended on this work up to June 30, 1904, by which 23.8 acres out of the original 30 of this shoal had been dredged to 25 feet depth, and a 16-foot depth had been secured over the central and largest portion of the shoal, in addition to a 20-foot depth in the main channel, making an important addition to the anchorage facilities of Providence Harbor.

In the river and harbor act of June 13, 1902, provision was made for the removal of the remaining portions of this shoal in connection with the project for an enlarged anchorage area in Providence Harbor, and nearly all of the remaining portions of the shoal were removed under the appropriation made by that act.

The removal of the shoal enables vessels to anchor outside of the channel, and thus removes an obstruction to vessels going to or from the Providence wharves.

For reference to reports containing more extended information, see Annual Report of the Chief of Engineers for 1905, page 85.

July 1, 1906, balance unexpended.....	\$324, 288. 13
Amount appropriated by sundry civil act approved March 4, 1907....	102, 778. 00
Amount appropriated by river and harbor act approved March 2, 1907..	90, 750. 00
	<hr/>
	517, 816. 13
June 30, 1907, amount expended during fiscal year, for works of improvement .....	241, 966. 99
	<hr/>
July 1, 1907, balance unexpended.....	275, 849. 14
July 1, 1907, outstanding liabilities.....	38, 812. 42
	<hr/>
July 1, 1907, balance available.....	237, 036. 72
	<hr/>
July 1, 1907, amount covered by uncompleted contracts.....	16, 361. 27

(See Appendix C 9.)

10. *Harbor at Fall River, Mass.*—Fall River lies at the mouth of Taunton River, in the northeastern angle of Mount Hope Bay, which empties into the ocean through Narragansett Bay and Sakonnet River. It forms the port of entry of the city of Fall River, the largest cotton manufacturing city in the United States.

Before improvement the depth of water in the reentrant in the wharf line north of the Old Colony Steamboat Company's wharf was only about 6 feet, and a considerable area of the harbor, especially in front of the upper wharves, carried much less depth of water than existed in its approaches.

The project of 1874 provided for deepening an area in front of the wharves immediately north of the Old Colony Steamboat Company's wharf 160 feet wide to 12 feet, and an additional width of 100 feet to 11 feet at mean low tide. This improvement was completed in 1878 at a cost of \$30,000.

The existing project, adopted by the river and harbor act of March 3, 1899, and enlarged by the act of June 13, 1902, provides for a channel 300 feet wide and 25 feet deep at mean low water along the city front between the Old Colony wharf and deep water at the upper end of the city front; also for a channel of the same dimensions through Mount Hope Bay to connect the deep water in front of the city with the deep water of Narragansett Bay, at a total estimated cost of \$175,411.94. Provision was made in this act for placing the work under the continuing-contract system.

The sum of \$174,001.50 had been expended on the existing project to June 30, 1907, by which the project had been completed.

The mean rise and fall of the tide is about 4.7 feet.

The improvement will give increased facilities for deeper-draft vessels.

For reference to reports containing more extended information, see Annual Report of the Chief of Engineers for 1905, page 86.

July 1, 1906, balance unexpended.....	\$2,015.50
June 30, 1907, amount expended during fiscal year, for works of improvement.....	605.00

July 1, 1907, balance unexpended.....	1,410.50
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(See Appendix C 10.)

11. *Harbor at Newport, R. I.*—This harbor is at the main entrance to Narragansett Bay, and all the year it serves as an easily accessible harbor of refuge to foreign and coastwise commerce.

Before improvement the capacity of the inner harbor was limited by shoals, and it was not adequate to the number and size of the vessels seeking it for refuge. The southern or main entrance was obstructed by a bar which stretched out from Goat Island and the northern entrance by a sharp, rocky spit near Rose Island, and the general business wharves of the city could not be reached at low tide by vessels drawing more than 8 feet. The mean tidal range is about 3.75 feet. Between 1873 and 1875, \$28,500 was appropriated to secure 12 feet depth in the harbor. This work was completed in 1876.

The approved project, adopted in 1880 and modified in 1882, 1883, 1884, 1890, and 1895, provided for widening and deepening of the channel from Narragansett Bay into Newport, so as to secure 15 feet depth at mean low water with at least 750 feet width; for the extension of the 13-foot depth and 10-foot depth anchorage basins, and for dredging a channel 10 feet deep along the State harbor line southward to opposite the gas company's wharf; for the partial cutting off of the shoal spit at the southern end of Goat Island, and for the construction of jetties on the western shore of Goat Island, so as to protect the end of this island from erosion and to prevent the drift of sand, etc., around the island into the adjacent parts of the harbor and channel, and for the removal of Spindle rock, a sharp, rocky spit near Rose Island; all at a total cost estimated in 1895 at \$206,200.

A small area of ledge rock was discovered in the fall of 1903 in the channel through the harbor opposite the Old Colony Steamboat Company's wharf, which had been the cause of serious injury to one of the boats of that company, and its removal was authorized by the Chief of Engineers with funds in hand. This was completed in July, 1904.

Shoaling having occurred in the channel opposite the wharf of the New England Navigation Company (formerly Old Colony Steamboat Company) and in the channel south of Goat Island, as well as at other points in the harbor, an allotment of \$10,000 was made from the appropriation "Emergencies in River and Harbor Works," act of March 3, 1905, for the removal of such shoals as were causing the chief difficulties. Work under this allotment was commenced March 29, 1905, and completed May 26, 1906, affording relief at the most needed points.

The amount expended on the original and modified projects prior to operations under the existing project was \$244,888.06, by which the projected work was completed.

The existing project, adopted by the river and harbor act of March 2, 1907, provides for dredging a channel 750 feet wide and 18 feet deep at mean low water around the southerly end of Goat Island and northward through the harbor, in accordance with House Document No. 121, Fifty-eighth Congress, second session, and for the extension of the 13-foot anchorage area southward to the harbor line and the removal of Nourmahal rock in Brentons Cove off the Fort Adams shore, to a depth of 18 feet, in accordance with House Document No. 438, Fifty-ninth Congress, second session, at a total estimated cost of \$250,900, of which \$85,000 was appropriated and \$165,900 authorized under a continuing contract, which latter amount remains to be appropriated.

The amount expended on the existing project up to the close of the fiscal year ending June 30, 1907, not including outstanding liabilities, was \$244.12, by which borings have been made in the area embraced by the project, in the southern part of the harbor, for use in preparing specifications for the work.

It is proposed to apply the existing balance and the amount estimated for profitable expenditure for the fiscal year ending June 30, 1909, to dredging the 18-foot channel through the harbor, enlarging the 13-foot anchorage area in the southern part of the harbor, and the removal of Nourmahal rock.

The proposed expenditure for the 18-foot channel is for new work and is to make that portion of the harbor available for that depth; the remainder of the proposed expenditures are for the extension of benefits already secured.

As the improvement of this harbor has progressed there has been a large increase in the size and number of vessels using the harbor. It has become an important port of call for orders for the large coal-ing fleet of not only Narragansett Bay but of the more eastern ports, and is the port of refuge for the fishing fleet as well as for landing and reshipment of the fish when the schools come upon this coast. At times the harbor is greatly crowded and a strong demand is made for a greater depth of water. The commerce for 1905 shows a tonnage of about 1,920,380 tons, principally fish, coal, and general merchandise.

For reference to reports containing more extended information, see Annual Report of the Chief of Engineers for 1905, page 87.

July 1, 1906, balance unexpended.....	\$348. 48
Amount appropriated by river and harbor act approved March 2, 1907.....	85,000. 00
	<hr/>
June 30, 1907, amount expended during fiscal year, for works of improvement.....	85,348. 48
	<hr/>
July 1, 1907, balance unexpended.....	592. 60
July 1, 1907, outstanding liabilities.....	84,755. 88
	<hr/>
July 1, 1907, balance available.....	131. 00
Amount (estimated) required for completion of existing project.....	84,624. 88
	<hr/>
Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907.....	165,900. 00
Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

(See Appendix C 11.)

12. *Harbor of refuge at Point Judith, Rhode Island.*—Point Judith is the southeastern extremity of South Kingston, R. I., and marks the southwestern entrance to Narragansett Bay. A long ledge, known as Squid ledge, extends for nearly a mile in a direction south by east about 1.5 miles west of the point.

At the adoption of the project this place was especially dangerous for vessels to pass during storms and even ordinarily bad weather.

The existing project of September 19, 1890, provides for the construction at this point of a national harbor of refuge nearly a mile square by means of stone breakwaters built partly on Squid ledge and planned so as to give protection against easterly, southerly, and westerly storms, the mainland itself forming a protection on the north, all at a total cost estimated in 1889 at \$1,250,000. This project was modified by the report of a Board of Engineers convened to consider and report upon the construction of this harbor, which was approved November 16, 1896, and provided for raising the crest of the eastern arm and extending the western arm to its originally projected length, at an estimated cost of \$444,311, and deferring the construction of the easterly detached breakwater as a part of the main project until the completion of the main breakwater should demonstrate its necessity or otherwise. The river and harbor act of June 13, 1902, made a further modification by providing for the construction of the easterly detached breakwater and continuing it to the shore, at an estimated cost of \$196,193 for the detached breakwater and \$187,558.80 for the shore extension. A further modification was made by the act of March 2, 1907, authorizing an extension seaward of the shore-arm breakwater at an additional estimated cost of \$186,248.20, making the total cost of the shore arm \$570,000 and a total estimate for the project and its modifications of \$2,264,311.

The river and harbor act of March 2, 1907, provided for the further extension of the easterly shore arm of the breakwater under the continuing-contract system, appropriating \$100,000 therefor and authorizing the expenditure of an additional \$170,000 (not yet appropriated) for its completion. Under date of May 11, 1907, a continuing contract was entered into for the extension of the shore arm seaward. The work is to be completed within ten months after notification of approval, exclusive of the months of December, January,



February, and March. Work under this contract was commenced June 15, 1907.

The sum of \$1,531,885.87 had been expended on this work up to June 30, 1907, of which \$6,417.32 was for maintenance. By this expenditure the main breakwater had been built to a total length of 6,970 feet with a height of 10 feet above mean low water, and the easterly shore arm had been completed for a distance of 1,353 feet out from the high-water line on shore to about 25 feet depth of water, with 110 feet forming the incomplete slope at the end.

Before the construction of the breakwater the area inclosed within the lines upon which it has been built and the shore was about 640 acres, of which 390 acres has over 25 feet of water and 198 acres additional over 18 feet.

Proceedings for the condemnation of land required for the shore end of the breakwater are in progress. The decree condemning the land to the uses of the United States was entered on May 26, 1906, and the commission to assess the land damages viewed the land May 23, 1907.

Five hundred and sixty-one vessels used the harbor of refuge during the year, of which 293 were schooners, 89 sloops, 40 barges, 66 steamers, 34 tugs, 16 steam yachts, 11 yawls, 6 schooner yachts, and 6 launches.

It is proposed to apply the existing balance and the amount estimated for profitable expenditure for the fiscal year ending June 30, 1909, toward the completion of the shore arm, and such other work as the available funds will permit.

For reference to reports containing more extended information, see Annual Report of the Chief of Engineers for 1905, page 89.

July 1, 1906, balance unexpended.....	\$118,384.55
Amount appropriated by river and harbor act approved March 2, 1907.....	100,000.00
	<hr/> 218,384.55
June 30, 1907, amount expended during fiscal year, for works of improvement.....	100,226.81
July 1, 1907, balance unexpended.....	118,157.74
July 1, 1907, outstanding liabilities.....	21,764.76
	<hr/> 96,392.98
July 1, 1907, amount covered by uncompleted contracts.....	223,934.79
Amount (estimated) required for completion of existing project.....	614,311.00
	<hr/> <hr/>
{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907.....	170,000.00
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897.....	

(See Appendix C 12.)

*13. Entrance to Point Judith Pond, Rhode Island.*—Point Judith Pond is a shallow salt pond, lying in the rear of the sandy beach of the Rhode Island shore, just west of Point Judith.

The improvement desired at this place by the people of the neighborhood is widening and deepening the present opening into the pond and the construction of jetties for the maintenance of such opening.

The State of Rhode Island and the town of South Kingston are making the opening into the pond.

No general project for the improvement of this channel has been formed. The appropriation of March 3, 1905, provided for the expenditure of \$10,000 to assist in the work in process of execution by the local authorities. This was expended in extending and strengthening the western jetty at the ocean end of the channel.

The river and harbor act of March 2, 1907, provides \$8,000 for "continuing improvement and for maintenance," "which amount shall be expended for dredging."

In 1905 the excavated channel through the beach proper was about 3,000 feet long and carried a navigable depth of about 6 feet, but for a like distance beyond this point there was practically no navigable depth at low tide, there being a wide sand bar crossed by irregular streams rarely carrying as much as 1 foot of water. On the pond side of this bar there was about 5 feet depth. No dredging through this bar would be permanent without some auxiliary directing works to control the flow of the current. An appropriation of \$6,000 was made at the last session of the Rhode Island general assembly, and it is expected that the use of the combined appropriations may result in some benefit to the work.

Up to June 30, 1907, \$12,000 had been expended in surveys, for the expenses of the Board of Engineers authorized by the river and harbor act of June 13, 1902, and for the extension of the west jetty.

For reference to reports containing more extended information, see Annual Report of the Chief of Engineers for 1905, page 90.

July 1, 1906, balance unexpended.....	\$552. 44
Amount appropriated by river and harbor act approved March 2, 1907.....	8, 000. 00

8, 552. 44

June 30, 1907, amount expended during fiscal year, for works of improvement.....	552. 44
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July 1, 1907, balance unexpended.....	8, 000. 00
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(See Appendix C 13.)

14. *Harbor of refuge at Block Island, Rhode Island.*—This island is about 14 miles east of the eastern end of Long Island, and about 10 miles distant from the nearest point of the mainland.

The object of the improvement is to furnish a harbor of refuge for medium-draft vessels engaged in foreign and coastwise commerce.

Before the construction of the present harbor Block Island had no harbor at all.

The mean tidal range is about 3 feet.

Between 1870 and 1876, \$285,000 was appropriated for a breakwater for a harbor for medium-draft vessels, this work being completed in 1878. Between 1880 and 1882, \$25,000 was appropriated for dredging an inner basin and the protection of the shore next to the breakwater, this work being completed in 1884. In 1884, \$15,000 was appropriated for additions to the old breakwater, this money being so spent and the work completed in 1884-85.

The project of 1884, as modified in 1888, provided for the construction of a harbor of refuge on the eastern side of the island, consisting of an enlarged inner harbor (or basin) 800 feet square for small ves-

sels and an exterior harbor for larger ones, at a total cost estimated in 1888 at \$75,000. This project was practically completed in 1893.

The total expenditure prior to commencing work on the existing project was \$399,000.

The existing project of June 3, 1896, provides for raising the entire breakwater to proper height and stopping sand leaks between certain points and dredging the main inner harbor to a depth of 10 feet, at an estimated cost of \$83,985.

At the adoption of the present project this harbor was neither large enough nor well enough protected for the proper harborage of the craft seeking refuge at this place during storms and bad weather.

The sum of \$97,925.09 had been expended on the existing project up to June 30, 1907, of which \$17,839.74 was for maintenance. By this expenditure the entrance to the inner harbor, which had shoaled up from the drift of sand through the breakwater, had been partially dredged to a depth of 12 feet and redredged to a depth of 10 feet several times. The north wall of the enlarged inner harbor had been strengthened and repaired, the work of repairing the main breakwater and making it sand tight had been completed, and the contract for dredging the inner harbor had been completed as far as funds would allow, but owing to the accumulation of sand during the progress of the work and the necessary use of a considerable portion of the funds for maintenance, as well as the occurrence of a large number of bowlders in the dredged area, only 81 per cent of the dredging was completed.

Proposals for dredging with funds provided by act of March 2, 1907, have been invited, to be opened July 17, 1907.

In 1906 the commerce amounted to about 37,060 tons, showing a decrease from previous years.

The additional work required to complete the existing project is for the purpose of extending the benefits already secured by the improvement.

For reference to reports containing more extended information, see Annual Report of the Chief of Engineers for 1905, page 91.

July 1, 1906, balance unexpended.....	\$2,727.73
Amount appropriated by river and harbor act approved March 2, 1907.	20,000.00
	<hr/>
	22,727.73
June 30, 1907, amount expended during fiscal year, for works of improvement.....	761.65
	<hr/>
July 1, 1907, balance unexpended.....	21,966.08
July 1, 1907, outstanding liabilities.....	162.43
	<hr/>
July 1, 1907, balance available.....	21,803.65

(See Appendix C 14.)

*15. Great Salt Pond, Block Island, Rhode Island.*—The Great Salt Pond is located about the center of Block Island, and contains an anchorage area of 150 acres for vessels drawing 18 feet and over. The work of converting the pond into a harbor of refuge by making a channel through the beach on the west, connecting it with deep water in the ocean, was started by the State of Rhode Island and the town of New Shoreham.

The channel, under the existing project of June 3, 1896, as modified in 1900, is to be 600 feet wide and have a central depth of 25 feet for

a width of 150 feet, sloping gradually to 12 feet in a width of 504 feet, the channel seaward to be protected on the south by a jetty extending to 350 feet beyond the original 18-foot contour, and on the north by a jetty about 1,200 feet long, and the sides of the channel where it passed through the original beach to be protected by stone revetments and sand fences, at a total estimated cost of \$305,000.

At the time the work commenced under the General Government a channel of varying width and depth had been dredged with the money appropriated by the State and town, which would permit of 12-foot draft being carried in.

The south jetty had been built out 837 feet, and a north jetty 250 feet long had also been built, but at a distance of 720 feet from the south jetty instead of 600 feet, as called for in the adopted project.

The mean rise and fall of the tide is about 3 feet.

Up to June 30, 1907, \$167,208.09 had been expended by the General Government on the existing project, of which \$9,803.24 had been used for maintenance and repair. By this expenditure the south jetty had been extended 439 feet beyond the originally projected length, making a total of 1,691 feet from the initial point on shore. Some damage done by a severe storm in the spring of 1900 had been repaired, and a channel 18 feet deep and 300 feet wide, with a central cut 25 feet deep and 35 feet wide, had been dredged; also a small amount of dredging had been done in removing a shoal which had formed near the outer end of the jetty.

The channel dredged in 1900 to a depth of 18 feet with a width of 300 feet has shoaled to some extent. The sides of this channel now have about 15 feet of water, from which it deepens to 18 feet toward the center. The 25-foot channel dredged in 1906 has maintained itself.

There remains, to complete the existing project, the construction of jetties as planned and dredging to secure the widths and depths projected.

The work required to complete the existing project is for the purpose of extending the benefits of the improvement.

The commerce of the Great Salt Pond is reported for the calendar year 1906 at 38,495 tons.

For reference to reports containing more extended information, see Annual Report of the Chief of Engineers for 1905, page 92.

July 1, 1906, balance unexpended.....	\$27, 099. 64
Amount appropriated by river and harbor act approved March 2, 1907.....	30, 000. 00

57, 099 64

June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$19, 757. 73
For maintenance of improvement.....	4, 550. 00
	<hr/> 24, 307. 73

July 1, 1907, balance unexpended.....	32, 791. 91
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Amount (estimated) required for completion of existing project....	105, 000. 00
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(See Appendix C 15.)

16. *Removing sunken vessels or craft obstructing or endangering navigation.*—Steamer Trojan, schooner Geo. V. Jordan, barge Baden, barkentine Bonnie Doon, barge Pemberton, barge Montana, and schooner Sagmore.

(a) *Steamer Trojan*, of the Windsor Line, between Boston and Philadelphia, was sunk in collision near the Vineyard Sound light-ship at western entrance to Vineyard Sound, Mass. Removal completed October 11, 1906.

(b) *Schooner Geo. V. Jordan*.—Sunk on Pollock Rip shoals, Mass. Removal of wreck completed November 9, 1906.

(c) *Barge Baden*.—This whaleback barge was sunk in Buzzards Bay, off Mishaum Point, Mass. After a long-continued attempt on the part of the owners to save the vessel, without success, the wreck was removed by the United States, the work being completed January 19, 1907.

(d) *Barkentine Bonnie Doon*.—Wrecked on Nantucket shoals and the hulk abandoned in the northerly part of Nantucket Sound, off Herring River. Removal completed April 1, 1907.

(e) *Barge Pemberton*.—Sunk in Vineyard Sound, Mass., about 1½ miles E. by N. from Nobska light-house. Removal completed April 30, 1907.

(f) *Barge Montana*.—Sunk near the bell buoy marking the entrance to Great Salt Pond, Block Island, R. I. Removal completed May 16, 1907.

(g) *Schooner Sagmore*.—Sunk in Vineyard Sound, Mass., off West Chop, Vineyard Haven, in May, 1907. Removal of this wreck was transferred to the United States Revenue-Cutter Service.

The amount expended during the year on the removal of wrecks is \$7,638.60.

(See Appendix C 16.)

#### EXAMINATIONS AND SURVEYS MADE IN COMPLIANCE WITH THE RIVER AND HARBOR ACT APPROVED MARCH 3, 1905.

Reports on preliminary examinations and surveys required by the river and harbor act approved March 3, 1905, of the following localities within this district were duly submitted by the district officer. They were reviewed by the Board of Engineers for Rivers and Harbors pursuant to law, and were transmitted to Congress and printed in documents as indicated.

1. *Preliminary examination and survey of New Bedford and Fairhaven harbors, Massachusetts, with a view to obtaining additional anchorage grounds and increased depth*.—Reports dated August 3, 1905, and May 18, 1906, respectively, are printed in House Document No. 271, Fifty-ninth Congress, second session. A plan for improvement at an estimated cost of \$527,000 is presented.

2. *Preliminary examination and survey of Newport Harbor, Rhode Island, with a view to extending the space for light-draft anchorage in the southern part thereof*.—Reports dated February 7 and September 20, 1906, respectively, are printed in House Document No. 438, Fifty-ninth Congress, second session. A plan for improvement at an estimated cost of \$165,900 is presented.

#### IMPROVEMENT OF RIVERS AND HARBORS IN CONNECTICUT AND OF PAWCATUCK RIVER, RHODE ISLAND AND CONNECTICUT.

This district was in the charge of Maj. Harry Taylor, Corps of Engineers. Division engineer, Col. Amos Stickney, Corps of Engineers, to June 4, 1907, and Col. John G. D. Knight, Corps of Engineers, since that date.

1. *Pawcatuck River, Rhode Island and Connecticut.*—The navigable part of the Pawcatuck River extends 5 miles from Westerly, R. I., to its outlet, in Little Narragansett Bay, through the northern part of which a navigable channel extends  $2\frac{1}{2}$  miles to Stonington Harbor, Connecticut, through which Long Island Sound is reached.

Before improvement the channel of the river was crooked and obstructed by numerous shoals, on some of which there was 1 to  $1\frac{1}{2}$  feet of water, and the greatest depth that could be carried through the bay channel was  $4\frac{1}{2}$  feet.

The original projects, that of 1871 for the river channel and that of 1879 for the channel across the bay, provided for depths of  $5\frac{1}{2}$  and 7 feet and widths of 75 and 200 feet, respectively. The expenditure on the original projects was \$97,500.01.

The present project, adopted in 1896, provides for a channel 10 feet deep from Stonington, Conn., to Westerly, R. I., with a width of 200 feet from Stonington to Avondale, R. I., a distance of about 4 miles; a width of 100 feet from Avondale to the lower wharves at Westerly, a distance of about 3 miles, and a width of 40 feet between the upper and lower wharves of Westerly, a distance of about one-half mile, at a total estimated cost of \$200,361.60. The river and harbor act of March 3, 1905, authorized the use of \$1,000 of the appropriation for the improvement of the Pawcatuck River in the removal of obstructions at Watch Hill, at the southeastern part of the Little Narragansett Bay. The greater portion of the obstructions was removed in January and February, 1906, at a cost of \$865.82.

On this project \$44,654.66 had been expended to June 30, 1907, therewith completing the section 40 feet wide along the wharves of Westerly, extending the 100-foot channel downstream 1,800 feet, and making a part channel through Little Narragansett Bay. Of this amount \$14,379.53 was applied to maintenance.

The maximum draft which could be carried June 30, 1907, was 8.5 feet in the bay channel, 7 feet in the river, and 6 feet near Watch Hill. The mean rise of tide is 2.6 feet at the mouth of the river and 2.3 feet at Westerly.

The effect of the improvement is to permit coal, lumber, and building material to be delivered in vessels at Westerly, and to ship therefrom granite in vessels instead of by rail, thus giving water competition for these materials, with a resulting benefit in the reduction of freight rates.

The available balance will be applied toward maintenance and the completion of the project.

The tonnage for 1906 was 60,786, valued at \$398,725.48.

July 1, 1906, balance unexpended.....	\$348. 77
Amount appropriated by river and harbor act approved March 2, 1907.....	33, 000. 00
	<hr/>
	33, 348. 77
June 30, 1907, amount expended during fiscal year, for works of improvement.....	3. 44
	<hr/>
July 1, 1907, balance unexpended.....	33, 345. 33
July 1, 1907, outstanding liabilities.....	36. 20
	<hr/>
July 1, 1907, balance available.....	33, 309. 13
	<hr/>
Amount (estimated) required for completion of existing project.....	131, 361. 60

(See Appendix D 1.)

2. *New London Harbor, Connecticut.*—New London Harbor, which comprises the lower 3 miles of the Thames River, has a navigable width of one-quarter to  $1\frac{1}{4}$  miles and depth of 26 feet or more in the main channel from Long Island Sound to the railroad draw-bridge which crosses the river above the New London dock front. This channel, especially opposite New London, follows the east bank. Between it and the city docks is a nearly level area having a general depth of 10 to 15 feet. Before improvement part of the docks was accessible to vessels of 16 to 18 feet draft at high tide only.

The original and present project, adopted by the act of June 13, 1902, provides for dredging and maintaining a ship channel 400 feet or more in width, 23 feet deep, and about 6,000 feet long. This channel leaves the deep water of the river opposite Fort Trumbull on the west side, skirts the water front of the city, including that of Winthrop Cove to the Central Vermont Railroad bridge and the east side of the Central Vermont dock, and joins the natural deep channel at a distance of about 4,000 feet upstream from the point of beginning. The estimated cost of the improvement was \$145,000, and \$1,000 per annum for maintenance. For map see House Document No. 392, Fifty-sixth Congress, first session.

Up to June 30, 1907, \$133,850.92 had been expended on the project.

The project dredging was completed under a continuing contract in October, 1904. This completed the project except at two small areas of ledge rock in the Fort Trumbull-Shaws Cove arm of the channel, where there were depths of about 18 feet, and at a part of a city pipe sewer crossing the middle of the dredged channel, where the least depth was 21.6 feet. The rock in the channel was removed in 1907. A draft of 23 feet can be carried to opposite all the principal docks. The additional work proposed is to maintain the improvement.

The effect of this improvement has been to materially reduce freight rates.

The mean range of tide is 2.6 feet.

Under a modification of the existing Thames River project, adopted in 1892, Shaws Cove, a branch of New London Harbor, has been dredged to 12 feet.

The tonnage of this port for the year 1906, principally coal, building material, oil, and steamboat freight, and exclusive of that pertaining to Shaws Cove and Thames River, was 697,139, valued at \$14,036,327.33, an increase of 19,285 tons over that reported for 1905.

July 1, 1906, balance unexpended.....	\$14,343.99
June 30, 1907, amount expended during fiscal year, for works of improvement .....	1,194.91
July 1, 1907, balance unexpended.....	13,149.08
July 1, 1907, outstanding liabilities.....	7,645.75
July 1, 1907, balance available.....	5,503.33

(See Appendix D 2.)

3. *Thames River, Connecticut.*—This is a tidal stream from Norwich, Conn., the head of navigation, to Long Island Sound, a distance of 15 miles. For 4 miles below Norwich the natural depths were 6 feet or more at low water with widths of 400 to 1,000 feet. Below this point depths were 13 feet or more and widths 800 to 3,000 feet.

The original project, adopted in 1836, provided for a channel 11 feet deep at low water, to be secured by dredging and building dikes. On this project \$40,300 had been expended when, in 1839, work was stopped, the project not having been completed.

The existing project, adopted June 23, 1866, and modified in 1879, 1882, 1888, 1892, and 1907, is to dredge and build training walls to secure a channel 200 feet wide with depths of 20 feet from New London to Allyn's Point and 14 feet thence 5 miles to Norwich; also to dredge Shaws Cove at New London to a depth of 12 feet. Estimates of cost were \$473,870 for construction and \$9,500 annually for maintenance.

Up to June 30, 1907, \$443,734.78 had been expended on this project and its modifications, of which \$25,093.31 had been applied to maintenance. The proposed training walls had been completed; a channel had been completed to Allyn's Point, 200 feet in width and 16 feet in depth; thence to Norwich the project depth of 14 feet had been secured in a channel varying in width from 100 to 200 feet; and the proposed dredging in Shaws Cove had been completed. The upper portion of the channel was redredged for maintenance during the year.

Mean range of tide is 2.6 feet at New London and 3.1 feet at Norwich.

With the balance on hand it is proposed to complete the project.

Commerce at Allyn's Point is coal, and at Norwich and intermediate landings it is mainly coal, lumber, cotton and wool, and steamboat freight. The tonnage for 1906 was 427,503, valued at \$2,788,754.76, including 20,829 tons, valued at \$126,912.70, for Shaws Cove commerce.

The work done has reduced the cost of transportation by enabling freight to be brought in vessels of 16 and 18 foot draft instead of 8 foot draft. The river commerce of the present day could not be carried except for the increased depths thus obtained.

The modification of project adopted by act of March 2, 1907, is printed in House Document No. 265, Fifty-ninth Congress, second session.

July 1, 1906, balance unexpended.....	\$27,407. 76
Amount appropriated by river and harbor act approved March 2, 1907.....	30,000. 00
	<hr/>
	57,407. 76
June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$6,641. 01
For maintenance of improvement.....	6,901. 53
	<hr/>
	13,542. 54
July 1, 1907, balance unexpended.....	43,865. 22
July 1, 1907, outstanding liabilities.....	4,191. 39
	<hr/>
July 1, 1907, balance available.....	39,673. 83
July 1, 1907, amount covered by uncompleted contracts.....	9,673. 83

(See Appendix D 3.)

4. *Connecticut River between Hartford, Conn., and Holyoke, Mass.*—This portion of the river is 34 miles long, and is naturally divided into three distinct sections. From Hartford to the foot of Enfield Rapids, 10½ miles, the river has a gentle slope with a sandy, shifting bottom; from the foot to the head of Enfield Rapids, 5½



miles, the total fall at low water is 32 feet, and the bed of the river is largely rock; from Enfield Falls to Holyoke, 18 miles, the river is of moderate width, gentle slope, fair depth, and stable bottom.

In its original condition the lower section had a navigable depth of 2 feet or less at low water; the second section could be navigated upstream only with great difficulty and only by boats of shallow draft, and the third section was navigable by boats drawing 4 to 5 feet of water.

At Enfield Rapids a canal with locks 80 feet in length and 18 feet in width, designed for boats with draft of about 3 feet at low water, has been constructed by private enterprise as part of a water-power development scheme.

Prior to June 30, 1898, \$93,059.70 was expended in the construction of wing dams and dredging to provide a temporary improvement below Enfield Rapids, and in extensive surveys and examinations which were made with a view to permanent improvement of the whole stretch from Hartford to Holyoke.

A complete history of the improvement of this section of the river, with maps and plans, is given in the report of the Chief of Engineers for 1878, pages 248-391.

No work of improvement has been carried on in this section of the river since 1886.

Examinations and surveys with a view to future permanent improvement have been made under the river and harbor acts of June 3, 1896, June 13, 1902, and March 3, 1905. The Board appointed by authority of the last-named act suggested three plans of improvement other than those which had been already reported upon. One of these plans provided for dredging, the use of wing dams and training walls, and rock excavation from Hartford up to a point above the mills at Windsor Locks; thence by a new lock and the upper portion of the existing canal, and thence to Holyoke, at a cost of \$1,465,600. This plan was approved by the Board of Engineers for Rivers and Harbors, provided that all rights claimed to be infringed by this work should be ceded to the United States without cost. The amount expended on this survey was \$22,838.47.

The appropriation of March 2, 1907, is for the purpose of investigation and further examination, in connection with the recommendation of the Board of Engineers for Rivers and Harbors referred to, to determine what rights may be infringed and if they can be obtained without cost to the United States.

To June 30, 1907, the amount expended from the appropriation of March 2, 1907, was \$33.05.

No permanent benefit has resulted from the work thus far done.

July 1, 1906, balance unexpended.....	\$9,101. 83
Amount appropriated by river and harbor act approved March 2, 1907.....	5,000. 00
	14,101. 83
June 30, 1907, amount expended during fiscal year, for works of improvement.....	33. 05
July 1, 1907, balance unexpended.....	14,068. 78
July 1, 1907, outstanding liabilities.....	20. 00
July 1, 1907, balance available.....	14,048. 78

(See Appendix D 4.)

5. *Connecticut River below Hartford, Conn.*—The part of the river under improvement is 50 miles long from Long Island Sound to Hartford. Beyond Hartford the river is navigable, by means of a small private canal at Windsor Locks, Conn., 34 miles to Holyoke, Mass., although the navigation is limited by reason of low fixed bridges and the inadequacy of the canal. Before beginning improvement below Hartford the available depth over Saybrook bar at the mouth of the river was 7 feet, and thence to Hartford at the shoalest of the river bars about 5 feet.

The original project, adopted in 1836, provided for the removal of the Saybrook bar by dredging. Up to 1843 an 11 to 12 foot channel had been dredged 50 feet wide and 1,500 feet long, at a cost of \$23,471.57. No further work was done until 1870, by which time the dredged channel had been nearly obliterated by storms and freshets.

The present project, adopted in 1870 and modified in 1873, 1880, 1887, and 1890, provides for completing two jetties at the Saybrook bar to a height of 5 feet above high water, with top width of 6 feet and side slopes of 1 on 1; raising the training wall, nearly 3,700 feet long, at the Hartford bars as may be found necessary by experience, but not to exceed 15 feet above low water; dredging the channel between the jetties to 12 feet depth and width of 400 feet and maintaining the channel by annual dredging at the various river bars to about 10 feet depth at mean low water and to a width as near 100 feet as practicable, at an estimated cost—

For annual dredging.....	\$10,000
Completing Saybrook jetties.....	60,000
Dredging channel between them.....	20,000
Raising Hartford dike.....	50,000
Total.....	140,000

For scope and history of the modifications see pages 120 and 121, Annual Report of the Chief of Engineers, 1900.

The act of June 13, 1902, authorized an expenditure of \$1,000 for removal of obstructions at mouth of Salmon River, a tributary to the Connecticut River.

Up to June 30, 1907, \$541,404.45 had been expended on this project, of which \$309,729.40 had been applied to maintenance.

The maintenance of the river bar channels by annual dredging has been held paramount in the project. Available funds heretofore have not been sufficient for enlarging the jetties or dike or for dredging at Saybrook bar. The jetties have maintained a channel nearly 12 feet deep, of narrow width, and annual dredging at the river bars has generally kept a half-width channel open so that Hartford-New York steamers and barges drawing from 9 to 11 feet, according to the river stage, have been but little detained, and then only at summer low river and before completion of the annual dredging. The maximum draft which could be carried at mean low water over the shoalest river bar on June 30, 1907, was 10 feet. The mean rise of tide is 3.6 feet at Saybrook jetties and on low river 1.5 feet at Hartford.

Sketches of the Connecticut River from Hartford to Rocky Hill and of Saybrook bar are printed in the Annual Report of the Chief of Engineers for 1885, page 636. The river from the Sound to Hartford is shown on Coast Survey charts 253-256.

The tonnage for the year 1906 amounted to 440,024 tons, mainly coal, lumber, building materials, and miscellaneous steamboat freight, valued at \$11,531,040.

The work done has reduced freights to Hartford and lower river ports materially. Without the improvements there could be but little freight traffic on the river.

The available balance will be applied to maintenance and continuing work on the approved project.

Notice, dated June 11, 1907, was served on the New York, New Haven and Hartford Railroad Company requiring removal of its old bridge over Connecticut River at Old Saybrook and Old Lyme, Conn., pursuant to the provisions of section 7 of act of Congress approved April 7, 1904, the said structure to be entirely removed by December 31, 1908.

July 1, 1906, balance unexpended.....	\$27,908.45
Amount appropriated by river and harbor act approved March 2, 1907.....	40,000.00
	<hr/> 67,908.45
June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$4,576.20
For maintenance of improvement.....	8,038.27
	<hr/> 12,614.47
July 1, 1907, balance unexpended.....	55,293.98
July 1, 1907, outstanding liabilities.....	2,552.33
	<hr/> 52,741.65
July 1, 1907, balance available.....	52,741.65
July 1, 1907, amount covered by uncompleted contracts.....	7,480.99
	<hr/> 80,000.00
Amount (estimated) required for completion of existing project....	80,000.00
(See Appendix D 5.)	

6. *Harbor of refuge at Duck Island Harbor, Conn.*—Duck Island Harbor is a bay on the north shore of Long Island Sound about 7 miles west of the mouth of the Connecticut River and midway between the harbors of New London and New Haven.

The project for this improvement, adopted by the act of September 19, 1890, provides for the construction of three riprap breakwaters of 3,000, 1,750, and 1,130 feet length, respectively, inclosing and sheltering an area of about 115 acres, with two entrances. The project height of the breakwaters is 10 feet above low water, with crown of 10 feet and slopes of 2 on 3 outside and 1 on 1 inside. The estimated aggregate cost is \$463,540. For map see Annual Report of the Chief of Engineers for 1887, page 644.

To June 30, 1907, \$116,309.25 had been expended, of which \$5,334.10 was for maintenance, and 2,770 linear feet of the west breakwater had been built, but with reduced cross section, extending westwardly from Duck Island to a low-water depth of 17 feet. The mean rise of tide is 3.8 feet.

The commerce to be benefited by this improvement is the passing commerce of Long Island Sound, which may find it necessary or convenient to seek shelter at this locality. Its value can not be satisfactorily estimated. From February 1 to June 23, 1907, 327 vessels were reported as using the harbor of refuge.

July 1, 1906, balance unexpended.....	\$867. 90
Amount recovered from defaulting contractor.....	3, 024. 85
July 1, 1907, balance unexpended.....	3, 892. 75
Amount (estimated) required for completion of existing project.....	349, 540. 00
(See Appendix D 6.)	

7. *Branford Harbor, Connecticut.*—Branford Harbor consists of three distinct parts: The outer harbor, approximately 1 mile wide and three-quarters of a mile deep; the inner harbor, about half a mile in diameter, separated from the outer harbor by a series of rocks, the principal ones of which are known as "The Mermaids;" and the river, which empties into the inner harbor from the northeast. The natural low-water depths when improvement began were: At the outside of the outer harbor, 15 to 16 feet, gradually shoaling to 8 feet near "The Mermaids;" through the inner harbor from "The Mermaids" to the mouth of the river, 7 to 8 feet; up the river for a distance of 1 mile, nearly to the lower docks, 12 feet or more. From the lower to the upper docks the channel gradually shoaled and narrowed so that the controlling depth was less than 6 feet and the width 25 to 50 feet. At the upper dock the stream is crossed by an earthen causeway, in which there is a small drawbridge which is rarely opened, although the stream is navigable for small craft to a fixed bridge about one-half mile above. Since the adoption of the present project a very general and uniform shoaling of 1 to 2 feet has taken place in the inner harbor, so that the controlling depth between "The Mermaids" and the mouth of the river, the shoalest place in the channel, is now only about 6 feet.

The original and present project, adopted by the act of June 13, 1902, and modified by the act of March 2, 1907, provides for an 8½-foot channel 100 feet wide in the upper part of the river between the lower and upper docks and through the shoals at the mouth of the river, at an estimated first cost of \$13,000. A report of a survey is given in the Annual Report of the Chief of Engineers, 1901, page 1189 et seq. A channel of full project depth and 75 to 100 feet wide has been dredged from the 8½-foot curve below the lower dock upstream to the upper docks. This work greatly facilitates the navigation of the upper part of the harbor, but the above-named shoaling at the mouth of the river prevents the full benefit of the increased depth in the upper portion of the channel. The maximum depth that could be carried June 30, 1907, from the entrance of the harbor to the head of the projected channel was 6 feet, and through the improved portion of the channel 8½ feet. The mean rise of tide is 6 feet.

The effect of this improvement has been to reduce freight rates.

The amount expended on this project to June 30, 1907, was \$4,873.44, of which \$13.16 was for maintenance.

The commerce of this harbor is mainly coal, iron, and molding sand. The tonnage for the year 1906 amounted to 25,960, valued at \$193,471.76, a decrease of 4,012 tons from that of 1905.

The available balance will be applied to completion of the approved project and maintenance of the improvement.

July 1, 1906, balance unexpended.....	\$3, 139. 72
Amount appropriated by river and harbor act approved March 2, 1907.....	5, 000. 00
	<hr/> 8, 139. 72
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	13. 16
July 1, 1907, balance unexpended.....	8, 126. 56
July 1, 1907, outstanding liabilities.....	2, 330. 95
	<hr/> 5, 795. 61
July 1, 1907, balance available.....	
July 1, 1907, amount covered by uncompleted contracts.....	3, 075. 00
(See Appendix D 7.)	

8. *New Haven Harbor, Connecticut.*—New Haven Harbor is formed by a bay on the north side of Long Island Sound, which extends inland about 4 miles and is from 1 to 2 miles wide. Mill and Quinnipiac rivers, navigable for about 1 and 3 miles, respectively, above their mouths, empty into the head of the harbor from the northeast. The original available low-water depth from the wharves to Cranes bar, one-third way down the harbor, was 9 feet; thence to Fort Hale, half-way down, it was 16 feet or over. Below Fort Hale was a broad bar of soft mud extending across the channel, with available depth of 13 feet. The harbor entrance was partly obstructed by several sunken rocks. In Quinnipiac River the available low-water depth was about 4 feet, and in the west branch of Mill River about 5 feet to the head of the present projected improvement. Above this point both rivers are for the most part available for navigation only at high tide. The entire east branch of Mill River ran nearly bare at low tide.

In 1870 a project was adopted for removal of sunken rocks at the harbor entrance. This work was not continued after 1875, when the harbor breakwaters were first proposed. In 1871 the project was extended to include deepening the harbor channel, the proposed depth and width being modified from time to time as appropriations were made until 1899, when the project provided for a channel 16 feet deep and from 400 to 700 feet wide from Long Island Sound to the head of the harbor and for a dike to contract the channel across Fort Hale bar, at a total estimated cost from beginning of \$348,000. This project was nearly completed, the deficiencies being in the length of channel arm of the dike, which was about two-thirds the projected length, and in the width of the channel across Fort Hale bar, which was only 200 feet wide. The total amount expended on these projects was \$325,695.66.

The last project, which was adopted by the act of March 3, 1899, provided for a channel 20 feet deep, 400 feet wide, and 4 miles long, from Long Island Sound to Canal dock; thence of same depth, 300 feet wide, one-half mile to Tomlinson bridge; three anchorage basins below Tomlinson bridge of 20, 16, and 12 feet depths; a channel up the Quinnipiac River 200 feet wide and 12 feet deep to Grand avenue, and a channel up the Mill River 12 feet deep and 200 feet wide to the junction of the two branches above Chapel street and thence 12 feet deep and 75 feet wide up each branch to Grand avenue. The act of March 3, 1899, making the first appropriation for this project, limited it to the portion below Tomlinson bridge, but the act of June 13, 1902, authorized the extension to the part above Tomlinson bridge, provided the cost should not exceed \$345,000, the amount authorized by

the act of 1899. The above project, including the improvement of the Quinnipiac and Mill rivers, except that part of the Quinnipiac River between Ferry street and Grand avenue, was completed April 26, 1904, mainly under continuing contract, and a channel 8 feet deep and 50 feet wide dredged in the Quinnipiac River between Ferry street and Grand avenue. The total appropriated for the project adopted by the act of 1899 amounts to \$280,073.90, being less than the authorized cost of the project by \$64,926.10.

Mill River, where the worst shoaling has taken place, was re-dredged during the past year.

For reference to maps and further details regarding the harbor and projects, see Annual Report of the Chief of Engineers, 1904, page 94.

The amount expended on the existing project up to the close of the fiscal year ending June 30, 1907, was \$289,999.13, of which \$16,792.92 was for maintenance.

The maximum draft which could be carried June 30, 1907, through the main channel to Tomlinson bridge was 19 feet at mean low tide; above Tomlinson bridge the maximum low-water draft which could be carried up Mill River to Grand avenue bridge was 12 feet in both branches; up Quinnipiac River to Ferry street bridge, 12 feet, and from Ferry street bridge to Grand avenue a little more than 6 feet. The mean rise of tide is 5.7 feet at entrance to the harbor and 6.6 feet at Tomlinson bridge.

The work done has enabled deeper-draft vessels to use the harbor than was formerly possible, with the resulting reduction of freight rates due to the larger vessels and increased facilities for handling freight made possible thereby.

The commerce of New Haven Harbor is mainly in coal, steamboat freight, shellfish and shells, lumber, steel billets, and pig iron. The tonnage for the calendar year 1906 was 1,847,633 tons, valued at \$45,873,106.76, a decrease of 278,599 tons from that reported for 1905.

July 1, 1906, balance unexpended.....	\$9,000.00
Amount appropriated by river and harbor act approved March 2, 1907.....	10,000.00

	19,000.00
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	620.89

July 1, 1907, balance unexpended.....	18,379.11
July 1, 1907, outstanding liabilities.....	9,952.84

July 1, 1907, balance available.....	8,426.27
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July 1, 1907, amount covered by uncompleted contracts.....	5,461.81
Amount (estimated) required for completion of existing project.....	64,926.10

(See Appendix D 8.)

9. *Breakwaters at New Haven, Conn.*—The original and existing project for this work, authorized by act of March 3, 1879, and approved January 31, 1880, and modified by act of September 19, 1890, in accordance with plans given in Annual Report of the Chief of Engineers, 1889, page 678, is to make a harbor of refuge at the entrance to New Haven Harbor by constructing four breakwaters—one 3,300 feet long, extending from Southwest ledge to Quixes ledge; one 5,000 feet long, extending from a point 1,000 feet north 54° east from Ludington rock, in a direction south 54° west across the rock;

one about 4,200 feet long, extending northwesterly from a point 6,000 feet south  $54^{\circ}$  west from Ludington rock, and one about 1,200 feet long, extending southwesterly from Morgan Point on the east side of the harbor entrance—the cross section of all these breakwaters to be 12 feet wide on top and 6 feet above mean high water, with outer slope 1 on 2 and inner slope 1 on 1. The estimated cost from the beginning, in 1880, was \$2,151,134. The anchorage which will be sheltered by the breakwaters exceeds 2,000 acres and has depths of 9 to 26 feet. The mean rise of tide is 5.7 feet.

For original report on project, see Annual Report of Chief of Engineers, 1880, page 449 et seq., and for modification of project and maps showing the location of the breakwaters as contemplated under the existing project see Annual Report of the Chief of Engineers for 1889, page 678 et seq.; 1890, pages 624 and 625, and 1896, page 702.

At the close of the fiscal year the breakwater from Southwest ledge to Quixes ledge had been completed 3,450 feet long, and 4,500 feet of the Ludington rock and 1,805 feet of west breakwater had been built, but with steeper slopes than called for by the project. The total expenditure to June 30, 1907, was \$878,698.43, of which \$4,223.51 was for maintenance.

The commerce now benefited and to be further benefited by this work is mainly the passing commerce of Long Island Sound. The projected breakwaters provide also an outer anchorage for vessels bound to and from New Haven and help to protect the entrance to New Haven Harbor proper from seas and to diminish channel filling. For the calendar year 1906 some 5,050 vessels sought refuge behind the breakwaters. The additional work proposed is for extension of benefit to commerce.

The available balance and the appropriation asked for will be applied to continuing construction of the west breakwater and to maintenance.

The river and harbor act of March 2, 1907, authorized continuing contracts for prosecution of this work in the sum of \$150,000, yet to be appropriated.

July 1, 1906, balance unexpended_____	\$642. 42
Amount appropriated by river and harbor act approved March 2, 1907 _____	100, 000. 00
	<hr/> 100, 642. 42
June 30, 1907, amount expended during fiscal year, for mainte- nance of improvement _____	340. 85
	<hr/> 100, 301. 57
July 1, 1907, balance unexpended_____	100, 301. 57
July 1, 1907, outstanding liabilities _____	12. 50
	<hr/> 100, 289. 07
July 1, 1907, balance available_____	100, 289. 07
	<hr/> <hr/> 222, 750. 00
July 1, 1907, amount covered by uncompleted contracts _____	222, 750. 00
Amount (estimated) required for completion of existing project__	1, 172, 134. 00
	<hr/> <hr/>
{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907 _____	150, 000. 00
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897.	
(See Appendix D 9.)	

10. *West River, Connecticut.*—This river lies between the city of New Haven and the town of West Haven. The head of navigation is at a railroad bridge about one-half mile upstream from the Kimberly Avenue Bridge. About 500 yards below this drawbridge the river widens into a shallow bay and joins New Haven Harbor south of Oyster or City Point. The natural channel, about 2,000 yards long through the middle of the bar, carried less than 3 feet at its shoalest part. A channel leading from the harbor to docks at Oyster Point had a controlling depth of 4.5 feet, but between Oyster Point and the channel along the West Haven docks was a wide flat nearly bare at low tide. The mean rise of tide is about 6.2 feet.

The project adopted by the river and harbor act of March 3, 1905, provided for a 9-foot channel, 100 feet wide, from the downstream corner of the 16-foot anchorage basin of New Haven Harbor, via Oyster Point and the dock frontage of West Haven, to Kimberly Avenue Bridge, at a cost of \$38,500, and \$500 for annual maintenance.

On June 30, 1907, a low-water draft of 9 feet could be carried from the 16-foot anchorage basin in New Haven Harbor upstream through the Kimberly Avenue Bridge to the railroad bridge above. The railroad bridge is a closed bridge, and no navigation is practicable above this point except by small unmasted vessels.

The report of survey of West River is published at page 996 and following, Annual Report of the Chief of Engineers, 1904, and the survey map is printed in House Document No. 73, Fifty-eighth Congress, second session.

Up to June 30, 1907, \$36,634.83 had been expended on the project, and a channel of project dimensions had been completed.

The effect of the improvement on freight rates, if any, is not known.

The principal articles of commerce are coal, oysters and shells, and building material. The tonnage for the calendar year 1906 was 128,820, valued at \$1,147,816.99.

July 1, 1906, balance unexpended.....	\$31, 715. 78
July 30, 1907, amount expended during fiscal year, for works of improvement .....	29, 850. 61

July 1, 1907, balance unexpended.....	1, 865. 17
July 1, 1907, outstanding liabilities.....	1, 865. 17

(See Appendix D 10.)

11. *Milford Harbor, Connecticut.*—This harbor is on the north shore of Long Island Sound, and consists of a broad, open bay, from the head of which a small tidal stream extends nearly a mile inland to the head of navigation. The original depth on the bar in the bay at the mouth of the river was less than 2 feet. In parts of the river the channel ran nearly bare. The mean rise of tide is about 6.2 feet.

The original project, adopted under the act of June 23, 1874, provided for a riprap breakwater 890 feet long from Welchs Point, on the east side of the mouth of the harbor, protection of the bluffs on the east shore from erosion by means of small stone jetties, a jetty on the east side to maintain the river-bar channel, and dredging a channel 4 feet deep and 100 feet wide across the bar, the whole estimated to cost \$85,000. This project was modified in 1878 and 1879 to provide for extending the 4-foot channel 60 feet wide upstream to the town dock and for a training dike off Burns Point, on the west



side of the river channel, nearly at right angles to the east-side jetty. The project thus modified was completed in 1880, except that the outer breakwater was not built, being deemed unnecessary in view of the provision of a harbor of refuge at New Haven. Under the act of June 14, 1880, a project was adopted for the extension of the 4-foot channel, 40 feet wide, upstream to the Straw Works wharf, and under the act of August 2, 1882, a revised project was adopted which provided for a channel 8 feet deep and 100 feet wide across the bar and upstream to Merwin's dock, at estimated cost of \$11,000.

In 1891 these projects were reported as completed and no further work necessary, except maintenance of jetties and dredged channels. It was stated in July, 1895, that as a result of private dredging there was a clear channel across the bar 12 feet deep and nowhere less than 80 feet wide. On the previous projects \$45,500, and for surveys \$1,600, were expended.

For further details regarding former projects see Annual Report of the Chief of Engineers for 1893, page 929, and for report on which present project is based see Annual Report of the Chief of Engineers for 1900, page 1357 et seq. For map see House Document No. 280, Fifty-sixth Congress, first session.

The existing project, authorized by act of June 13, 1902, for completion at a cost of \$15,000, consists in dredging and maintaining a channel across the bar and through the lower harbor, 100 feet wide and 10 feet deep, to Merwin's wharf, with an anchorage basin of same depth of about 5 acres area on the east side of the channel between the long dike and the harbor line and a channel through the upper harbor from Merwin's wharf to the Straw Works wharf, 90 feet wide and 6 feet deep. The estimated cost for maintenance was \$1,000 biennially. The first cost of the improvement was subsequently ascertained to be \$25,000. The amount expended on this project to June 30, 1907, is \$23,649.62.

The 6-foot channel has been extended upstream to a point about 500 feet above the town dock, a portion of the anchorage basin, about  $2\frac{1}{2}$  acres in area, adjacent to the 10-foot channel, dredged, and a basin, 1.6 acres in area, dredged on the opposite side of the channel opposite Merwin's wharf. Owing to ledge rock it was impracticable to complete this project within the estimate. The work done facilitates navigation in the lower part of the harbor, and the extension of the 6-foot channel to the town dock renders it practicable to land cargoes of coal at this dock, which it was formerly extremely difficult to do. The development of the anchorage basins greatly relieves congestion in the lower part of the harbor, due to the anchoring of small pleasure craft and oyster schooners in that portion of the harbor.

On June 30, 1907, a low-water draft of 10 feet could be carried over the bar and up as far as Merwin's wharf, thence 6 feet draft to a point about 500 feet above the town dock, and thence draft of about  $2\frac{1}{2}$  feet can be carried to the Straw Works dock. No navigation is practicable above this dock.

The commerce of this harbor consists almost entirely of oysters, shells, coal, and fertilizer, the former predominating. The tonnage for the calendar year 1906 amounted to 26,815 tons, valued at \$395,885, an increase of 7,585 tons over that reported in 1905.

July 1, 1906, balance unexpended.....	\$1,477.88
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	127.50

July 1, 1907, balance unexpended.....	1,350.88
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(See Appendix D 11.)

12. *Housatonic River, Connecticut.*—This is a rapid river running southward through Massachusetts and Connecticut, emptying into Long Island Sound east of Stratford Point, about 5 miles east from Bridgeport Harbor. At Derby, 13 miles from its mouth, it receives the discharge of the Naugatuck River. Derby and Shelton are at the head of navigation. About a mile above there is a large power dam across the Housatonic River; above the pool of this dam the river is rocky and shoal.

• The original depth on the worst bars in the river (6 in number) was from 3.5 to 4.5 feet. There was also a bar across the river mouth, with about 4 feet depth.

The original project for improvement, adopted under the act of March 3, 1871, provided for a jetty at Sow and Pigs reef; removing Drews rock; a breakwater at the mouth of the river, and making a channel 7 feet deep, 200 feet wide through the bar at the mouth and 150 feet wide in the river, at total estimated cost of \$404,961. In 1887 the estimates were revised and a modification of the project proposed a breakwater or jetty at the mouth of the river 5,750 feet long, extending about south-southeast from Milford Beach 3,250 feet; thence parallel to and 500 feet from the channel 2,500 feet farther, to the 12-foot curve in Long Island Sound, the inner arm of the jetty to be 3 feet above mean low water, top width 6 feet, side slopes 1 on 1; the outer arm to be 6 feet above high water, top width 12 feet, outer slope 1 on 2, inner slope 1 on 1; and a channel 7 feet deep, 200 feet wide at the outer bar and 100 feet wide through the river, at a total estimated cost of \$202,000, and \$4,000 annually for maintenance, all in addition to amount already expended. This modification was adopted under the act of August 11, 1888, and work on the breakwater was begun July 10, 1889. In 1893 the project was further modified to provide for building a small dike in the river below Stratford.

For maps see Annual Report of the Chief of Engineers for 1882, page 616, and for reports on various surveys and projects see Annual Reports of the Chief of Engineers for 1871, page 781; 1887, Part I, page 607; 1888, Part I, page 554.

The present project for improvement is the project of 1871, subsequently enlarged or modified as above, and the estimated cost from the beginning is \$275,500.

Up to June 30, 1907, \$252,443.03 had been expended on this project, of which \$63,245.39 had been applied to maintenance. At that date the project was completed, except that the dike below Stratford was not built to the full projected length and the outer arm of the breakwater was only about 4 feet high above high water, 5 feet wide on top, and the side slopes much steeper than called for by the project. A channel of project dimensions had been dredged from the mouth of the river to Derby, but had deteriorated from the action of spring freshets and been redredged from time to time.

On June 30, 1907, 8 feet draft could be carried across the outer bar and thence about 6 feet to Derby. The mean rise of tide at Derby is 4.2 and at the mouth of the river about 6.3 feet. The work done has enabled vessels to enter the lower river in safety instead of waiting for high tide in an exposed situation outside. A large part of the commerce could not have been carried on without the improved channel. The navigable channel to Derby materially reduces freight rates at that and adjacent towns, as otherwise all freight would have to be handled by rail and with no competition.

The commerce is largely in coal. A considerable quantity of oysters and oyster shells is shipped from near the mouth of the river. The tonnage for the calendar year 1906 was 54,496, valued at \$298,649.62, a decrease of 13,442 tons from that reported for 1905.

The available balance will be applied to redredging at the bar channels, where needed, and in continuing work on the breakwater.

July 1, 1906, balance unexpended.....	\$10,351.70
Amount appropriated by river and harbor act approved March 2, 1907.....	20,000.00
	<hr/>
	30,351.70
June 30, 1907, amount expended during fiscal year, for maintenance of improvement .....	10,344.73
	<hr/>
July 1, 1907, balance unexpended.....	20,006.97
July 1, 1907, outstanding liabilities.....	17.82
	<hr/>
July 1, 1907, balance available.....	19,989.15
	<hr/>
July 1, 1907, amount covered by uncompleted contracts.....	7,650.00
Amount (estimated) required for completion of existing project.....	27,000.00
(See Appendix D 12.)	

13. *Bridgeport Harbor, Connecticut.*—This consists of a shallow bay, about 1 mile wide at the mouth and  $1\frac{1}{2}$  miles long, into the extreme northwest corner of which empties the Poquonock River, a small tidal stream navigable for about 1 mile, and into the northeast corner of which another small stream about three-fourths of a mile long, known as Johnsons River, empties. Midway between these two streams is Yellow Mill Pond, a tidal basin about 1 mile in length. Black Rock Harbor, now considered part of Bridgeport Harbor, lies about  $2\frac{1}{4}$  miles to the westward. Both harbors are inner portions of a large bay of Long Island Sound lying between the eastern part of Stratford Point and Fairfield reef. Black Rock Harbor is about one-half mile wide at the mouth and 1 mile long, with two branches at its head, the east one a mile long, known as Cedar Creek, and the west one about three-fourths of a mile long, known as Burr Creek. The original low-water depth on the bar at the mouth of Bridgeport Harbor was about 5 feet; in the Poquonock River from 2 to 5 feet. In Johnsons River the bed of the stream was nearly bare in its upper half. Yellow Mill Pond was generally 4 to  $4\frac{1}{2}$  feet deep at high tide and its lower part bare at low tide. The original depth in Cedar Creek was 2 to 4 feet, and in Burr Creek the bottom was nearly dry.

Congress appropriated \$10,000 in 1836 and an equal amount in 1852 for improving the main Bridgeport Harbor. These sums were expended in dredging near the mouth of the harbor, making channels 60 to 100 feet wide and 8 feet deep or more at low tide. The depth

did not prove permanent. In 1871 and at various times thereafter the original project was enlarged to afford a 15-foot main-harbor channel, a 12-foot channel 200 feet wide in Yellow Mill Pond to Stratford avenue, a 9-foot Poquonock River channel, a 12-foot anchorage, and to protect the harbor entrance by two breakwaters, all estimated to cost \$285,000. This project was completed in 1898, except as to capacity of the 15-foot channel.

The amount expended on the projects above named was \$317,848.50.

At Black Rock Harbor, between 1836 and 1838, \$21,550 was expended in building a sea wall across a breach in the southern part of Fayerweather Island. In 1884 a project was adopted for protecting the upper part of Black Rock Harbor by a breakwater about one-half mile long between Fayerweather Island and the mainland and for making a 6-foot channel 80 feet wide in Cedar Creek. The channel had been made, the breakwater built to full length, but with reduced cross section, and the project was considered as completed July 1, 1894. Subsequently repairs were made on the old sea wall on Fayerweather Island. The amount expended for Black Rock Harbor as a separate improvement was \$72,900.

For details of original projects and their modifications see Annual Reports of the Chief of Engineers, 1902, pages 133 and 134, and 1903, pages 116 and 117.

In the act of March 3, 1899, Congress adopted a project for Bridgeport Harbor which provided, at an estimated cost of not exceeding \$300,000, for—

First. The main channel, 18 feet deep, 300 feet wide from the outer bar to the inner beacon, thence 200 feet wide to the lower or Stratford Avenue Bridge across the Poquonock River.

Second. Three anchorage basins: One 18 feet deep, 500 feet wide, and 2,000 feet long adjoining the main channel on the west above the inner beacon; one 12 feet deep, 500 feet wide, and 900 feet long adjoining the main channel on the west between the 18-foot anchorage and Naugatuck wharf, and one 12 feet deep at east side of channel between the steel works point and the lower bridge.

Third. Poquonock River channel, from the lower bridge to the head of navigation, about 1 mile, 12 feet deep and 100 feet wide.

Fourth. Yellow Mill channel, from the main channel to the head of Yellow Mill Pond, about 1 mile, 12 feet deep and 100 feet wide.

Fifth. Johnsons River channel, from the main channel to the head of navigation, about  $1\frac{1}{4}$  miles, 9 feet deep and 100 feet wide.

Sixth. Black Rock channel, from the head of Black Rock Harbor to the junction of Cedar and Burr creeks, thence up each of these creeks to the head of navigation, with lengths, respectively, of  $1\frac{1}{2}$  miles and one-half mile, 9 feet deep, and 100 feet wide.

Seventh. The repair and maintenance of the outer and inner breakwaters of the main channel, and the one connecting Fayerweather Island with the mainland as now built, and the construction and maintenance of shore protection on Fayerweather Island to check the shifting of the beach.

An appropriation of \$50,000 was made in the act cited and a continuing contract authorized, under which work was begun July 9,

1900, and carried on, with many interruptions and delays, until January 1, 1906, at which time the contract was 61 per cent completed. On account of the unsatisfactory progress, this contract was annulled May 10, 1906, and the work relet. Work under the new contract was commenced July 25, 1906, and completed May 17, 1907, completing the project as authorized in 1899, except a section of Burr Creek, the inner end of Yellow Mill channel, and the inner end of Johnsons River, where, on account of ledge rock, the full project dimensions of the channels were not obtained. Amount dredged during the year, 796,793 cubic yards.

The main channel and 18-foot anchorage basin were redredged to full project dimensions during the year where shoaling had taken place since the original dredging was done.

The amount expended on this project to June 30, 1907, was \$223,785.58, of which \$22,899.99 was applied to maintenance.

The act of March 2, 1907, authorized the extension of the project to include an anchorage basin 22 feet deep, 1,280,000 square feet in area opposite the inner breakwater, deepening the main entrance channel to 22 feet as far as the inner end of the 22-foot anchorage basin, an additional 12-foot anchorage basin 608,600 square feet in area northwest of the 22-foot basin, and two breakwaters for the protection of the deep anchorage basin, at an estimated cost of \$463,000. The act appropriated \$113,000, and authorized continuing contracts in the additional sum of \$350,000, yet to be appropriated for completing the project.

Under authority of the act of March 2, 1907, a contract for the construction of the breakwaters has been made.

The amount expended on the project of 1907 to June 30, 1907, was \$71.42.

The maximum draft that could be carried June 30, 1907, through the improved channels at mean low tide is 18 feet through the main channel from the outer end to the lower bridge; in the Poquonock River, about 12 feet; in the Yellow Mill channel, 12 feet; in Johnsons River, 9 feet; at Black Rock, about 9 feet to the head of navigation in both branches of Cedar Creek; in Burr Creek, about 7 feet to its head. The mean rise of tide is 6.5 feet.

The balance on hand and additional appropriations will be applied to completing the project and to maintenance.

The work done has greatly facilitated the navigation of the harbor and made the present commerce possible and materially reduced freight rates.

The commerce of this harbor is chiefly in coal, lumber, iron, building material, oysters, and general merchandise. Tonnage for calendar year 1906 was 951,244 tons, valued at \$22,134,653.19, an increase of 6,315 tons over that reported for 1905.

Reports of examination and survey containing the enlarged project are printed in House Documents Nos. 275 and 521, Fifty-ninth Congress, second session.

July 1, 1906, balance unexpended.....	\$144, 875. 78
Amount appropriated by river and harbor act approved March 2, 1907.....	113, 000. 00
	<hr/> 257, 875. 78
June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$117, 223. 20
For maintenance of improvement.....	18, 786. 66
	<hr/> 136, 009. 86
July 1, 1907, balance unexpended.....	121, 865. 92
July 1, 1907, outstanding liabilities.....	751. 88
	<hr/> July 1, 1907, balance available.....
	121, 114. 04
July 1, 1907, amount covered by uncompleted contracts.....	81, 900. 00
Amount (estimated) required for completion of existing project.....	350, 000. 00
	<hr/>
• { Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unex- pended July 1, 1907.....	40, 000. 00
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897.	
(See Appendix D 13.)	

14. *Norwalk Harbor, Connecticut.*—This harbor consists of the tidal part of Norwalk River extending from Norwalk, the head of navigation, to the river mouth, about 3 miles, and of an outer or main harbor lying between Norwalk Islands and the mainland. South Norwalk is on the west bank, about  $1\frac{1}{2}$  miles below Norwalk. The original depth in the river up to South Norwalk was about 5 feet; between there and Norwalk the river bed was nearly bare at low tide.

The original project, adopted under the act of June 10, 1872, and modified by the terms of the act of June 14, 1880, provided for a channel 100 feet wide and 8 feet deep from the outer harbor to South Norwalk, and thence 6 feet deep to Norwalk. This project was considered completed in 1892 at a cost of \$83,000, although portions of the channel between Norwalk and South Norwalk were only 60 feet wide. The act of August 18, 1894, appropriated \$15,000 for improving the inner harbor, and indicated the points where work was to be done. In accordance therewith a project was adopted for removing to 6 feet depth the shoal at Ferrys Point, below Norwalk, and, if funds permitted, for widening with depth of 9 feet the bend at Keysers Island, near the river mouth. This project was completed in 1897 at a cost of \$15,000. A project adopted by the act of June 3, 1896, provided for a channel 10 feet deep and 150 feet wide from the outer harbor to South Norwalk, widening two points near the entrance, and the maintenance of this channel and the 6-foot channel between South Norwalk and Norwalk, at estimated first cost of \$62,000, and \$2,000 annually for maintenance. This project was completed October 3, 1905, and the amount expended on it to June 30, 1907, was \$36,883.83, of which \$13,924.27 was expended for maintenance.

The present project, adopted by the act of March 2, 1907, provides for the restoration of the 10-foot by 150-foot channel to South Norwalk, for a channel 8 feet deep, of a general width of 100 feet from South Norwalk to Norwalk, and for a channel 6 feet deep, 2,900 feet long, of a general width of 75 feet, to the docks at East Norwalk, and for maintenance of these channels, at an estimated first cost of \$63,500, and \$8,000 per annum for maintenance.

The maximum draft that could be carried at low water June 30, 1907, to the South Norwalk docks was 10 feet and to the Norwalk docks 6 feet. The mean rise of tide is 7.1 feet.

For reference to reports and maps regarding this harbor and former projects, see Annual Report of the Chief of Engineers for 1904, page 103. For present project, see House Document No. 262, Fifty-ninth Congress, second session.

The commerce of this harbor is mainly in coal, oysters, lumber, wood pulp, building material, and general merchandise, and on all these items the improvement has effected a material reduction in freight rates. The tonnage for calendar year 1906 amounted to 251,759 tons, valued at \$5,050,456.74, an increase of 15,744 tons over that reported for 1905.

July 1, 1906, balance unexpended.....	\$17. 17
Amount appropriated by river and harbor act approved March 2, 1907.....	63, 500. 00
	<hr/> 63, 517. 17
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	68. 00
	<hr/> 63, 449. 17
July 1, 1907, balance unexpended.....	63, 449. 17
July 1, 1907, outstanding liabilities.....	31. 20
	<hr/> 63, 417. 97
July 1, 1907, balance available.....	63, 417. 97

(See Appendix D 14.)

15. *Harbors at Fivemile River, Stamford, Southport, Greenwich, and Saugatuck River, and Westport Harbor, Connecticut.*—(a) *Fivemile River Harbor.*—This is a tidal inlet about 1 mile long and from 100 to 1,000 feet wide. The natural low-water depth at the mouth was about 3 feet, shoaling to zero about halfway up the harbor and to about plus 2.5 feet at extreme head. The original and present project of improvement, adopted under authority of the act of August 11, 1888, provides for a dredged channel 8 feet deep and 100 feet wide, extending up the harbor about 6,000 feet from its mouth. The estimated cost from the beginning, as revised in 1894, was \$45,000.

For further details regarding this harbor, see page 192, Annual Report of the Chief of Engineers, 1901.

Up to June 30, 1907, \$32,800.42 had been expended on this project, of which \$1,847.30 had been for maintenance. At that date a channel of project dimensions had been dredged about 4,200 feet up the harbor and thence about 500 feet farther, with project depth, and width of 75 feet. No dredging has been done above this point. About 75 per cent of the project is completed. The maximum draft that could be carried to the upper end of the improved channel is 8 feet, and no navigation is possible beyond this point except at high tide, when a draft of from 4 to 4½ feet can be carried about 1,900 feet farther to the head of navigation. The mean rise of tide is 7.2 feet.

The available balance will be applied toward maintenance and completion of the project by widening the channel to project dimensions and extending it upstream as funds permit.

The commerce of this harbor is mainly confined to the oyster industry, which could not be carried on to its present extent without the improved channel. Traffic for calendar year 1906 amounted to

9,712 tons, valued at \$157,834.75, a decrease of 6,839 tons from that reported for 1905.

It is not believed that the improvement has affected freight rates.

July 1, 1906, balance unexpended.....	\$213. 28
Amount allotted from appropriation by river and harbor act approved	
March 2, 1907.....	7, 000. 00
	7, 213. 28
June 30, 1907, amount expended during fiscal year, for maintenance of improvement .....	13. 70
July 1, 1907, balance unexpended.....	7, 199. 58
July 1, 1907, outstanding liabilities.....	4. 77
July 1, 1907, balance available.....	7, 194. 81
•Amount (estimated) required for completion of existing project.....	5, 000. 00

(b) *Stamford Harbor*.—This consists of a bay on the north shore of Long Island Sound and of two tidal inlets known as the east and west branches, extending to the head of navigation at the city of Stamford. The original depth in the west branch was from 1 foot to 3 feet, gradually increasing in the bay to a depth of 12 feet. The east branch was originally a small marshy creek, deepened by private dredging to a depth of about 8 feet and which had shoaled so that when work was begun by the Government in 1892 the available depth was only about 6½ feet.

The original project, adopted under authority of the river and harbor act of 1886, was for a 5-foot channel 80 feet wide to the head of the west branch. This was considered completed in 1892 after an expenditure of \$20,000, the channel being 5 feet deep and 100 to 140 feet wide at the bends, but only from 50 to 70 feet wide for the last thousand feet at the upper end.

The present project, adopted under authority of the act of July 13, 1892, provides for a channel in the west branch 7 feet deep, 150 feet wide, and about 1½ miles long, with a basin of same depth between harbor lines at the head of the harbor and in the east branch, as approved October 5, 1892; a channel 9 feet deep and 100 feet wide for a length of about 8,535 feet and 50 feet wide for about 1,200 feet farther to the head of the harbor. The estimated cost was \$123,500. A modification to give increased width at upper end of east branch was approved February 12, 1901.

For reports on surveys and projects, see Annual Report of the Chief of Engineers, 1884, Part I, page 672; 1891, Part I, page 849; 1893, page 954 (map, p. 956).

Up to June 30, 1907, \$69,198.60 had been expended on this project, of which \$4,024.99 had been for maintenance. At that date the channel in the east branch afforded approximately project depth and widths of from 70 to 100 feet from the entrance to the steamboat dock, and the section above this point was completed, the widths ranging from 65 to 70 feet. The channel in the west branch had been dredged to project dimensions from its outer end to the south end of the basin and with a width of 60 feet along both sides and across the upper end of the basin. Owing to large bowlders, full depth was not made along the west side of the basin, so that the available depth which



could be carried June 30, 1907, to the extreme head was 7 feet on the outside and not over 5 feet on the west side. About 55 per cent of the project is completed. At the close of the year a draft of about 9 feet could be carried through the east branch channel to its head. The mean rise of tide is 7.4 feet.

The available balance will be applied toward maintenance and completion of the project in widening the channel in the east branch and dredging the basin of the west branch.

The commerce of this harbor consists mainly of coal, lumber, stone, sand, clay, ores, and steamboat freight. The tonnage for calendar year 1906 amounted to 249,175 tons, valued at \$3,379,355.57, an increase of 27,050 over that reported for 1905. A daily line of freight steamers, landing at the east branch, runs to New York. The improvements made have rendered it possible for the steamers to run on schedule time and to enter the harbor at any stage of the tide, which they were unable to do previously, and have materially reduced freight rates.

July 1, 1906, balance unexpended.....	\$190. 49
Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	58,000. 00
	<hr/>
	58,190. 49
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	266. 29
	<hr/>
July 1, 1907, balance unexpended.....	57,924. 20
July 1, 1907, outstanding liabilities.....	353. 31
	<hr/>
July 1, 1907, balance available.....	57,559. 09

(c) *Southport Harbor*.—This is a tidal part of Mill River at town of Southport, about 1 mile long and averaging less than 100 yards wide, 6 miles west of Bridgeport. The original depth was probably less than 2 feet at the entrance to the harbor, shoaling to about plus 1 foot at the upper end. Work was begun in this harbor by the Government in 1829 and prosecuted with various intermissions until 1878. During this time a dike inside and breakwater or jetty outside were built, and a channel 60 feet wide and 4 feet deep dredged across the outer bar. In 1878 a project was adopted for dredging a channel 100 feet wide and 4 feet deep across the bar and upstream 1,200 feet from the outer end of the jetty, and thence in a bifurcated channel to the nearest docks. In 1882 this project was reported as substantially completed, \$31,587.23 having been spent since the beginning of work in 1829.

The present project, adopted by act of June 13, 1902, is to dredge a channel 6 feet deep through the outer bar to the upper docks 100 feet wide to the turn above White Rock, and thence in two branches, each 60 feet wide; to repair the breakwater and to remove two points of ledge from the channel to a depth of 7 feet. The original estimated first cost of this improvement was \$13,200, and for yearly maintenance \$300, to be expended biennially, but on account of the development of large quantities of bowlders during the dredging it became evident that this estimate would be greatly exceeded before the work could be completed, and in 1906 the estimated cost was increased to \$15,111 for this work.

For further details regarding this harbor and its former projects see Annual Report of the Chief of Engineers, 1897, page 986.

Up to June 30, 1907, \$17,749.94 had been expended on this project, of which \$1,038.15 had been for maintenance. At that date a channel of project depth and 75 to 100 feet width had been dredged to the turn above White Rock, and thence with full depth and widths of 40 to 60 feet up the east branch and along the dock front for about 200 feet; one point of ledge rock had been removed, and the breakwater repaired. About 55 per cent of the project is completed.

The maximum draft that can be carried through the improved portion of the channel is 6 feet. Above this point, where no dredging has been done, a draft of 3 to 4½ feet can be carried to the upper docks at low tide. Above the upper end of the projected channels the harbor is navigable only at high tide, and for a distance of about half a mile. The mean rise of tide is 6.6 feet.

The improved channel permits vessels to enter the harbor without being compelled to wait outside the bar in an exposed situation for the tide to rise.

The available balance will be applied toward maintenance and completion of the project in widening the main channel to 100 feet, completing the east branch channel, dredging the west branch, and removing ledge rock.

The commerce of this harbor consists mainly of farm produce, general merchandise, oysters, and coal. The tonnage for calendar year 1906 amounted to 6,708 tons, valued at \$67,640, a decrease of 6,294 tons from that reported for 1905.

The effect of the improvement on freight rates, if any, is not known.

July 1, 1906, balance unexpended.....	\$144. 59
Amount allotted from appropriation by river and harbor act approved	
March 2, 1907.....	2, 000. 00
	<hr/>
	2, 144. 59
June 30, 1907, amount expended during fiscal year, for maintenance	
of improvement .....	5. 53
	<hr/>
July 1, 1907, balance unexpended.....	2, 139. 06
	<hr/>
Amount (estimated) required for completion of existing project.....	13, 111. 00

(d) *Greenwich Harbor*.—This is a shallow bay about 2 miles east from the New York State line, extending about a mile northward from Long Island Sound. The original low-water depth was about 6 feet to the lower docks. Above this point it shoaled rapidly to 3 feet 1,000 feet above and to about plus 2 at the head of the harbor. The original and present project, adopted in the act of June 3, 1896, is to dredge a channel 90 feet wide from the mouth of the harbor to the causeway at its head, a distance of about a mile, to be 9 feet deep to the steamboat dock and 6 feet deep above, the upper end to be enlarged to form a turning basin. The estimated first cost was \$20,000. Page 860, Annual Report of the Chief of Engineers, 1895, gives report of examination upon which the project is based. Up to June 30, 1907, \$20,578.18 had been expended on this project, of which \$2,989.42 had been for maintenance.

This project was completed September 2, 1905. The work done has enabled vessels to enter the harbor with 9 feet draft at low tide,

thus permitting the regular steamer to make trips without waiting for tide. Above the steamboat dock a draft of 6 feet can be carried at low tide to the head of navigation. The mean rise of tide is 7.5 feet.

The commerce of this harbor consists mainly of coal, lumber, building material, and general merchandise. The tonnage reported for calendar year 1906 amounted to 108,348, valued at \$3,869,500, an increase of 16,348 over that reported for 1905.

The effect of the improvement on freight rates, if any, is not known.

July 1, 1906, balance unexpended.....	\$1,323.90
Amount allotted from appropriation by river and harbor act approved .	
March 2, 1907.....	1,000.00
	<hr/>
	2,323.90
June 30, 1907, amount expended during fiscal year, for maintenance of improvement .....	135.08
	<hr/>
July 1, 1907, balance unexpended.....	2,188.82

(e) *Saugatuck River and Westport Harbor, Connecticut.*—For description of these localities and statement of work under original project, 1826, and its modifications to about 1871, see Annual Report of the Chief of Engineers, 1901, page 189. The total amount expended for the same is \$19,444.

The present project, adopted in 1892, originally provided for a channel 4 feet deep and 60 feet wide up to Westport, at an estimated cost of \$10,000.

As a result of a survey authorized by the act of August 18, 1894, the project was modified in 1896 to provide for repairing the Cedar Point breakwater, removing a ledge opposite Stony Point, or dredging around it, and removing bowlders from the channel, at an estimated cost of \$8,000, and the total estimated cost was in consequence increased to \$18,000.

A sketch of this river and harbor is printed in the Annual Report of the Chief of Engineers for 1894, page 670, and report of the survey authorized in 1894 is printed in the Annual Report of the Chief of Engineers for 1896 and, with map, in House Document No. 67, Fifty-fourth Congress, first session.

The total amount expended on the present project up to the close of the fiscal year ending June 30, 1907, was \$13,000, of which \$96.92 was for maintenance. The 4-foot channel had been completed to Westport, head of navigation, with width generally of 60 feet, and the Cedar Point breakwater had been repaired and extended. About 60 per cent of the project is completed. The mean rise of tide is about 7 feet.

Completion of the project requires further removal of bowlders and dredging to full project dimensions at the channel opposite Westport. Improvements made have rendered navigation of the river practicable at less than half-tide stages by vessels plying there.

The available balance will be applied to maintenance and the completion of the project.

The commerce comprises coal, lumber, farm produce, and steamboat freight. The tonnage for calendar year 1906 was 16,665, valued at \$158,694.16, a decrease of 11,180 tons from that reported for 1905.

The effect of the improvement on freight rates, if any, is not known.

July 1, 1906, balance unexpended.....	\$62. 13
Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	2, 000. 00
	<hr/> 2, 062. 13
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	62. 13
July 1, 1907, balance unexpended.....	<hr/> 2, 000. 00
Amount (estimated) required for completion of existing project.....	<hr/> 3, 000. 00

## CONSOLIDATED.

July 1, 1906, balance unexpended.....	\$1, 934. 39
Amount appropriated by river and harbor act approved March 2, 1907.....	70, 000. 00
	<hr/> 71, 934. 39
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	482. 73
July 1, 1907, balance unexpended.....	<hr/> 71, 451. 66
July 1, 1907, outstanding liabilities.....	358. 08
July 1, 1907, balance available.....	<hr/> 71, 093. 58
Amount (estimated) required for completion of existing project....	<hr/> 21, 111. 00

(See Appendix D 15.)

16. *Removing sunken vessels or craft obstructing or endangering navigation.*—(a) *Wrecks of canal boats City of Utica and Gettman.*—These wrecks were old hulks which had been sunk in Johnsons River, Bridgeport Harbor, several years ago. They were removed in March, 1907, at a total cost of \$500.

(b) *Wreck of the three-masted barge Buena Ventura.*—This barge was wrecked in Long Island Sound, about  $1\frac{1}{2}$  miles off Montauk light, and was removed by the revenue cutter *Mohawk* on December 15, 1906, at a cost of \$126.47, which was paid by the Engineer Department.

(See Appendix D 16.)

## EXAMINATIONS AND SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF MARCH 3, 1905.

Reports on preliminary examinations and surveys required by the river and harbor act approved March 3, 1905, of the following localities within this district were duly submitted by the district officer. They were reviewed by the Board of Engineers for Rivers and Harbors, pursuant to law, and were transmitted to Congress and printed in documents as indicated:

1. *Preliminary examination of New London Harbor, Connecticut, with a view to obtaining a depth of 30 feet in the main entrance channel from deep water to the railroad bridge, and therefrom with a width of 400 feet to the naval station, with such width and such anchorage space as may be necessary.*—Report dated May 21, 1906, is printed in House Document No. 178, Fifty-ninth Congress, second session. The proposed improvement is not considered necessary nor advisable.

2. *Preliminary examination of Thames River to Allyn's Point, Connecticut.*—Report dated October 22, 1906, is printed in House Document No. 265, Fifty-ninth Congress, second session. A plan is presented for improvement at an estimated cost of \$16,250, with \$1,500 annually for maintenance after completion.

3. *Preliminary examination and survey of Bridgeport Harbor, Connecticut, with a view to enlarging and improving the outer harbor.*—Reports dated November 21 and December 18, 1906, respectively, are printed in House Documents Nos. 275 and 521, Fifty-ninth Congress, second session. A plan for improvement at an estimated cost of \$560,000, with \$10,000 annually for maintenance, is presented.

4. *Preliminary examination and survey of Norwalk Harbor, Connecticut, with a view to a channel 8 feet in depth to the head of navigation; a channel 6 feet in depth to East Norwalk, and widening the main channel at South Norwalk so as to afford a turning basin.*—Reports dated December 16, 1905, and October 23, 1906, respectively, are printed in House Document No. 262, Fifty-ninth Congress, second session. A plan is presented for improvement at an estimated cost of \$83,000, with \$8,000 for maintenance annually after completion.

5. *Preliminary examination and survey of Hay (West) Harbor, Fishers Island, New York.*—Reports dated September 16, 1905, and September 20, 1906, respectively, are printed in House Document No. 269, Fifty-ninth Congress, second session. The harbor is not deemed worthy of improvement at the present time.

REPORT OF BOARD OF ENGINEERS ON IMPROVEMENT OF CONNECTICUT RIVER BETWEEN HARTFORD, CONN., AND HOLYOKE, MASS., MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT APPROVED MARCH 3, 1905.

Report dated December 7, 1905, by a Board of Engineers on improvement of *Connecticut River between Hartford, Conn., and Holyoke, Mass., by open-channel work or methods other than those already reported upon*, was duly submitted and reviewed by the Board of Engineers for Rivers and Harbors pursuant to law. It was transmitted to Congress and printed in House Document No. 323, Fifty-ninth Congress, second session. The locality is not deemed worthy of improvement by the United States in the manner proposed.

IMPROVEMENT OF RIVERS AND HARBORS IN NEW YORK ON LONG ISLAND SOUND AND ON THE SOUTHERN SHORE OF LONG ISLAND, OF HUDSON RIVER AND HARBORS THEREON, AND OF HARLEM AND EAST RIVERS, NEW YORK.

This district was in the temporary charge of Col. W. R. Livermore, Corps of Engineers, to September 5, 1906; in the charge of Col. D. W. Lockwood, Corps of Engineers, to May 31, 1907, and in the charge of Col. John G. D. Knight, Corps of Engineers, since May 31, 1907. Division engineer Col. Amos Stickney, Corps of Engineers, to June 4, 1907.

1. *Port Chester Harbor, New York.*—This harbor, situated at the boundary between the States of New York and Connecticut, consists of the tidal part of Byram River and of a bay at its mouth opening into Long Island Sound. The depth in the river before improvement was 1 foot, and Salt rock, in the river, and Sunken rock, in the bay, were considered to be dangerous obstructions.

The original project for this improvement was adopted in 1872 and modified in 1884 and 1888. It proposed to remove Salt rock to 9 feet below mean low water, to build a breakwater from Sunken rock to Byram Point, and to dredge and maintain a channel to the Port Chester wharves, at a total cost of \$57,000. Up to 1899, at a total cost of \$52,000, this project had been completed, except the dredging in the upper harbor.

The existing project, approved March 3, 1899, provides for a channel 12 feet deep at mean low water and 70 feet wide from deep water in the bay up to the town wharf, and thence 9 feet deep and 60 feet wide to the steamboat wharf, the work to be done by dredging and rock removal. Estimated cost, \$25,000. By act of 1907 the project was extended to include removal of ledges of rock opposite the southerly point of Fox Island.

Up to June 30, 1907, \$33,000 had been expended on the present project; of this amount \$10,000 was for maintenance.

About 92 per cent of the work proposed under the present project has been completed and has resulted in securing a channel of the projected width and depth, except at and opposite the southerly point of Fox Island, where the width is reduced by ledges of rock to about 60 feet. The channel has probably deteriorated somewhat.

The available funds are to be applied to completing the improvement and to maintenance.

The maximum draft that could be carried June 30 1907, at mean low water is estimated at 12 feet up to the town wharf; thence 9 feet to the steamboat wharf, and above the steamboat wharf  $2\frac{1}{2}$  feet. Mean range of tides, 7.4 feet. The head of navigation is at a fixed bridge at Mill street, about 900 feet above the steamboat dock. The total length of navigable channel from Long Island Sound to the bridge is about  $1\frac{1}{2}$  miles.

The commerce of this harbor, mainly in coal, building materials, manufactured goods, and farm produce, amounted to 140,000 tons, valued at \$4,936,000, in 1898; to 169,500 tons, valued at \$6,256,000, in 1899; to 181,000 tons, valued at \$7,269,500, in 1900; to 327,500 tons, valued at \$9,118,000, in 1901; to 237,000 tons, valued at \$900,000, in 1902; to 240,000 tons, valued at \$3,940,000, in 1903; to 255,000 tons, valued at \$4,590,000, in 1904; to 293,000 tons, valued at \$7,365,000, in 1905, and to 265,000 tons, valued at \$6,870,000, in 1906.

The effect of the improvement has probably been to reduce the freight rates since the channel has been deepened.

Detailed description of this improvement is printed in Reports of the Chief of Engineers for 1897, page 1084, and 1900, page 1378. Sketches of the river and harbor are printed in Reports of the Chief of Engineers for 1885, page 658, and for 1889, page 716.

Amount appropriated by river and harbor act approved March 2, 1907. \$6,500.00  
July 1, 1907, balance unexpended..... 6,500.00

(See Appendix E 1.)

2. *Mamaroneck Harbor, New York.*—This harbor, situated on the north shore of Long Island Sound, consists of a narrow inlet opening into a shallow, broad bay. Before improvement the channel to the old steamboat wharf, half a mile up the inlet, had a depth of 5 feet at mean low water, gradually decreasing to 1 foot at the upper

wharves. Various rocks at or near the mouth of the inlet obstructed navigation.

The present project, approved August 2, 1882, and modified April 27, 1899, provides for the removal of Round rock to a depth of 4 feet, and Bush rock and Inner Steamboat rock to a depth of 7 feet at mean low water; and for making a channel 7 feet deep at mean low water and 100 feet wide from the harbor entrance to the upper wharves. Estimated cost, \$43,000.

Up to June 30, 1907, \$40,000 had been expended on this work; of this amount \$4,628.50 was for maintenance.

About 82 per cent of the work proposed under the project has been completed, and has resulted in a channel with a uniform depth of 7 feet at mean low water and a width of from 70 to 100 feet from the harbor entrance to the turn at Hog Island, and thence 100 feet wide to the upper wharves. The channel has probably deteriorated somewhat.

The maximum draft that could be carried June 30, 1907, at mean low water is estimated at 7 feet. Mean range of tides, 8 feet. The head of navigation is at a fixed bridge just above the upper wharves. The total length of navigable channel from Long Island Sound is about 1 mile.

The commerce of this harbor is principally coal and building material and manufactured goods, amounting to 29,095 tons, valued at \$482,092, in 1896; to 51,673 tons, valued at \$877,180, in 1897; to 20,705 tons, valued at \$51,598, in 1901; to 48,495 tons, valued at \$75,000, in 1902; to 26,230 tons, valued at \$337,000, in 1903; to 49,589 tons, valued at \$859,242, in 1904; to 54,944 tons, valued at \$201,398, in 1905; and to 15,756 tons, valued at \$131,090, in 1906.

The effect of the improvement has probably been to reduce the freight rates since the channel has been deepened.

Detailed description of this improvement can be found in Report of the Chief of Engineers for 1900, page 1381. Sketch of harbor is printed in Report of the Chief of Engineers for 1903, page 859.

Amount (estimated) required for completion of existing project----- \$7, 628. 50

(See Appendix E 2.)

3. *Larchmont Harbor, New York.*—This harbor, situated on the northwest shore of Long Island Sound, 4 miles distant from New York City limits, is about half a mile wide and five-eighths of a mile long. It is exposed to easterly and southerly storms. Two submerged rocks (Umbrella rock and Huron rock) formerly obstructed the entrance, which has a depth of 18 feet, gradually diminishing toward the head of the bay.

The original project for this improvement, adopted September 19, 1890, provided for building two breakwaters to protect the anchorage ground, one to extend from Umbrella rock to Umbrella Point and the other from Huron rock to Long Beach Point, at an estimated cost of \$105,000. Work under this project was suspended in 1891 after the first appropriation of \$5,000 had been expended in commencing the two breakwaters.

The present project, adopted March 3, 1899, provides for building a breakwater extending southwardly 1,440 feet from the 6-foot curve off Long Beach Point and for the removal of Huron rock to a depth of 14 feet at mean low water. Estimated cost, \$108,000. The project

was extended by act of 1907 to include removal of ledges adjoining Huron rock.

Up to June 30, 1907, \$64,161.23 had been expended on this project, all for improvement.

About 60 per cent of the work proposed under the present project has been completed, and as a result the breakwater has been built to full projected section to a length of 1,410 feet, and Huron rock and a portion of the adjoining ledge removed to depths of 14 and 12 feet, respectively.

The available funds are to be applied to completing the removal of ledges adjoining Huron rock and to maintenance.

The maximum draft that could be carried June 30, 1907, over the shoalest part of the entrance channel at mean low water is estimated at 18 feet. The general depth of the anchorage area of the harbor is from 6 to 12 feet at mean low water. Mean range of tides, 7.4 feet. The harbor is about half a mile wide and extends rather more than half a mile inland. It is a basin with no definite channel.

The harbor has but little commerce. It is mainly used by the Larchmont Yacht Club, by coasting and fishing vessels for night anchorage, and as a harbor of refuge.

It is doubtful whether local freight rates have been affected by the improvement.

Detailed description of this improvement is printed in Report of the Chief of Engineers for 1900, page 1383. A sketch of the harbor is printed in Report of the Chief of Engineers for 1903, page 860.

July 1, 1906, balance unexpended-----	\$4, 997. 95
Amount appropriated by river and harbor act approved March 2, 1907.	14, 000. 00

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18, 997. 95

June 30, 1907, amount expended during fiscal year, for works of im-	
provement -----	4, 159. 18

July 1, 1907, balance unexpended-----	14, 838. 77
Amount (estimated) required for completion of existing project-----	29, 000. 00

(See Appendix E 3.)

4. *Harbor at Echo Bay, New York.*—This harbor is on the north shore of Long Island Sound, 2 miles distant from New York City limits. It is landlocked, except toward the southeast, and has a good anchorage. Nearly all of the water transportation of the town of New Rochelle is carried on through this harbor.

The original project for improvement, adopted in 1875, provided for the removal of two ledges, known as Start rock and Sheepshead reef, to 7 and 9 feet depth at mean low water, respectively, at an estimated cost of \$38,955.38.

Prior to 1902 the sum of \$22,000 had been appropriated, with which Start rock was reported wholly and Sheepshead reef partly removed to the projected depths, and a channel 40 feet wide and 4 feet deep at mean low water was dredged from Beauford Point to within 300 feet of the head of the harbor.

The project adopted by the river and harbor act of June 13, 1902, contemplated the completion of the original plan by the removal of the remainder of Sheepshead reef and Start rock, at an estimated cost of \$17,000. This work was completed September 25, 1903, at a total cost of \$8,546.68.



The river and harbor act of March 3, 1905, directed an examination to be made of Long rock, with a view to its removal, and authorized the expenditure of any balance remaining from previous appropriations for this purpose. The removal of such part of the rock to 6 feet below mean low water as the available funds (\$8,453.32) would permit was authorized by the Secretary of War August 21, 1906. Of this amount \$7,777.86 was expended to June 30, 1907, leaving a balance of \$675.46 in addition to the amount appropriated March 2, 1907.

The present project, adopted March 2, 1907, provides for completing the removal of Long rock, at a total estimated cost of \$10,000.

About 42 per cent of the work proposed under the present project has been completed and has resulted in securing a depth of about 6 feet at mean low water and 120 feet wide at Beauford Point.

The available funds are to be expended in completing the removal of Long rock and in maintenance.

The maximum draft that could be carried to Beauford Point on June 30, 1907, is estimated at 6 feet at mean low water. The general harbor anchorage ranges from 9 to 18 feet at mean low water. The mean range of tide is about  $7\frac{1}{4}$  feet. The head of navigation is at a dock about 1,500 feet above Beauford Point. The harbor is about one-fourth mile wide and one-third mile long. The total length of navigable channel extending beyond the deep water of the harbor is about one-fifth mile.

The commerce of this harbor is principally manufactured goods and coal and building materials, and was reported as amounting to 99,000 tons, valued at \$500,000, in 1902; to 129,400 tons, valued at \$1,434,000, in 1903; to 151,200 tons, valued at \$1,647,500, in 1904; to 193,650 tons, valued at \$2,071,800, in 1905; and to 270,460 tons in 1906, valued at \$2,789,208.

The effect of the improvement has probably been to reduce the freight rates since the rocks have been removed.

For detailed description of work see Report of the Chief of Engineers for 1900, page 1429. A sketch of the locality is printed in Report of the Chief of Engineers for 1903, page 862.

Report on examination for removal of Long rock is printed in House Document No. 182, Fifty-ninth Congress, second session.

July 1, 1906, balance unexpended.....	\$8, 453. 32
Amount appropriated by river and harbor act approved March 2, 1907.....	12, 000. 00

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20, 453. 32

June 30, 1907, amount expended during fiscal year, for works of improvement.....	7, 777. 86
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July 1, 1907, balance unexpended.....	12, 675. 46
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(See Appendix E 4.)

5. *Bronx River and East Chester Creek, New York.*—(a) *Bronx River.*—This stream empties into the East River north of Hunts Point. The navigable part extends from its mouth to West Farms, a distance of 3 miles. At this point it is crossed by a dam. The natural depth at the mouth was 4 feet at mean low water, and decreased ascending the stream to less than 1 foot at the head of navigation.

The project for improvement, adopted by the act of June 3, 1896, provides for making a channel 4 feet deep at mean low water and 100 feet wide from the entrance to Barlow street; thence to Dongan street 60 feet wide, and thence to the head of navigation 50 feet wide, the work to be done by dredging and rock removal. Estimated cost, \$85,985.

Up to June 30, 1907, \$35,875.84 had been expended on the project, all for improvement.

About 40 per cent of the work proposed under the present project has been completed and has resulted in a channel with depths of from 3 to 6 feet at mean low water and with a diminishing width of from 100 to 50 feet, except where reduced by ledges of rock, from the mouth to the turn east of the gas works. Above this point the channel remains as previously reported. The dredged channel has probably deteriorated somewhat.

The available funds are to be applied to continuing the improvement and to maintenance.

The maximum draft that could be carried June 30, 1907, over the shoalest part of the channel at mean low water from the mouth to the turn east of the gas works was about 3 feet; above this point, 1 foot. Mean range of tide is 6.6 feet at mouth and 6 feet at West Farms. The head of navigation is at a dam just beyond the dye works. The total length of navigable channel is about 3 miles.

The commerce of this river is mainly coal, cotton goods, drugs for dyeing purposes, ice, and building materials. It amounted to 139,310 tons, valued at \$526,025, in 1897; to 171,300 tons, valued at \$1,985,700, in 1899; to 153,137 tons, valued at \$500,000, in 1902; to 77,710 tons, valued at \$536,400, in 1903; to 42,286 tons, valued at \$196,642, in 1904; to 181,093 tons, valued at \$820,482, in 1905; and to 341,538 tons, valued at \$1,720,097, in 1906.

The effect of the improvement has probably been to reduce the freight rates since the channel has been deepened.

Details of improvement can be found in Report of the Chief of Engineers for 1900, page 1389. A sketch of a part of the stream is printed in Report of the Chief of Engineers for 1904, page 1016.

July 1, 1906, balance unexpended.....	\$21,000.00
Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	23,000.00
	<hr/>
	44,000.00
June 30, 1907, amount expended during fiscal year, for works of im- provement .....	375.84

July 1, 1907, balance unexpended.....	43,624.16
Amount (estimated) required for completion of existing project.....	6,485.00

(b) *East Chester Creek*.—This is a small tidal stream emptying into Pelham Bay. It was originally navigable at high tide for vessels drawing 7 feet as far as Lockwoods, a distance of  $2\frac{1}{4}$  miles.

The project for improvement, adopted March 3, 1873, provided for a channel 100 feet wide and 9 feet deep, mean high water, from deep water in Pelham Bay to a point 3,000 feet above Lockwoods. Estimated cost, \$136,500; subsequently reduced to \$124,000, as modified in 1891.

Up to June 30, 1907, \$107,073.02 had been expended on the project; of this amount \$16,981.80 was for maintenance.

The project has been completed and has resulted in a channel 9 feet deep at mean high water and about 100 feet wide from Pelham Bay to a point 3,000 feet above Lockwoods. The channel has deteriorated to a considerable extent in the upper reaches.

The available funds are to be applied to maintenance.

The maximum draft that could be carried over the shoalest part of the channel on June 30, 1907, is estimated at 6 feet at mean high water. Mean range of tides is 7.1 feet. The head of navigation is at the upper end of the artificial channel. The total length of navigable channel is about 2 $\frac{3}{4}$  miles.

The commerce, mainly in coal, building material, stone, and miscellaneous freight, amounted to 94,928 tons, valued at \$2,199,186, in 1895; to 286,428 tons, valued at \$1,957,224, in 1899; to 99,750 tons, valued at \$870,500, in 1902; to 104,655 tons, valued at \$572,800, in 1903; to 146,955 tons, valued at \$963,263 in 1904; to 206,275 tons, valued at \$1,755,850, in 1905; and to 282,655 tons, valued at \$3,063,360 in 1906.

The effect of the improvement has probably been to reduce the freight rates since the channel has been deepened.

For detailed reports see Reports of the Chief of Engineers for 1897, page 1089, and 1904, page 1016. A sketch of the stream is printed in Report of the Chief of Engineers for 1904, page 1016. For references to reports on examinations and surveys, see Report of the Chief of Engineers for 1904, pages 112 and 1061.

July 1, 1906, balance unexpended .....	\$2, 516. 71
Amount allotted from appropriation by river and harbor act approved March 2, 1907 .....	6, 000. 00
	<hr/> 8, 516. 71
June 30, 1907, amount expended during fiscal year, for maintenance of improvement .....	89. 73
July 1, 1907, balance unexpended .....	8, 426. 98
July 1, 1907, outstanding liabilities .....	134. 50
July 1, 1907, balance available .....	<hr/> 8, 292. 48

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July 1, 1906, balance unexpended .....	\$23, 516. 71
Amount appropriated by river and harbor act approved March 2, 1907 .....	29, 000. 00
	<hr/> 52, 516. 71
June 30, 1907, amount expended during fiscal year:	
For works of improvement .....	\$375. 84
For maintenance of improvement .....	89. 73
	<hr/> 465. 57
July 1, 1907, balance unexpended .....	52, 051. 14
July 1, 1907, outstanding liabilities .....	134. 50
July 1, 1907, balance available .....	<hr/> 51, 916. 64
Amount (estimated) required for completion of existing project .....	6, 485. 00
(See Appendix E 5.)	

6. *Harbors at Port Jefferson, Mattituck, Huntington, Glencove, Flushing Bay, Canarsie Bay, and Sag Harbor, N. Y.*—(a) *Port Jefferson Harbor.*—This is a large and deep inland bay, situated on

the north shore of Long Island, and connected with Long Island Sound by a narrow entrance.

Before improvement the channel depth outside the entrance was but 4 feet at mean low water, whereas the depth in the harbor was 12 feet and more, at low tide, up to within 300 feet of the wharves of Port Jefferson village.

The first project for improvement was adopted in 1871, and completed in 1883, at a total cost of \$79,000. Two jetties were built to shelter the inlet channel, one east of the inlet, 1,390 feet long, and one west, 940 feet long, both of scant cross section. A channel 8 feet deep at mean low water and 100 feet wide was dredged through the inlet and shoal outside.

The existing project for improvement, adopted September 19, 1890, and modified August 18, 1894, provides for dredging a channel through the harbor entrance 12 feet deep and 200 feet wide, to be protected by extending and enlarging the previously built jetties. Estimated cost, \$145,000.

Up to June 30, 1907, \$78,435.15 had been expended on the present project; of this amount \$5,929.64 was for maintenance and \$443.65 was returned to the United States Treasury, this amount being an unexpended balance from the emergency act of April 28, 1904.

About 50 per cent of the work proposed under the present project has been completed, and has resulted in securing a channel 12 feet deep at mean low water, and 200 feet wide, and in completing the east jetty to its full projected section for a distance of 1,380 feet, except at the shore end, where it is covered by sand. The west jetty is 940 feet long, with scant cross section. No work has been done on this jetty under the present project. It is reported that some shoaling has occurred in the dredged channel.

The available funds are to be applied to continuing the improvement and to maintenance.

The maximum draft that could be carried over the shoalest part of the channel June 30, 1907, is estimated at 12 feet at mean low water. Mean range of tides at entrance, 7 feet; at Port Jefferson wharves, 6.2 feet. The total length of navigable channel from Long Island Sound to Port Jefferson wharves is about  $2\frac{1}{2}$  miles. The harbor is about 2 miles long and three-fourths of a mile wide.

The commerce consists principally of coal, building materials, farm produce, fish, and general merchandise, and amounted to 24,940 tons, valued at \$360,200, in 1898; to 42,130 tons, valued at \$2,145,940, in 1899; to 46,670 tons, valued at \$776,000, in 1903; to 8,832 tons, valued at \$90,424, in 1904; to 19,650 tons, valued at \$565,700, in 1905, and to 118,705 tons, valued at \$2,544,900, in 1906.

The effect of the improvement has probably been to reduce the freight rates since the channel has been deepened.

For detailed report see Report of the Chief of Engineers for 1900, page 1393. A sketch of Port Jefferson Harbor is printed in Report of the Chief of Engineers for 1900, page 866.

July 1, 1906, balance unexpended-----	\$9, 726. 71
Amount allotted from appropriation by river and harbor act approved March 2, 1907-----	24, 000. 00
	<hr/> 33, 726. 71
June 30, 1907, amount expended during fiscal year:	
For works of improvement-----	\$7, 305. 51
For maintenance of improvement-----	1, 956. 35
Repaid to U. S. Treasury-----	443. 65
	<hr/> 9, 705. 51
July 1, 1907, balance unexpended-----	24, 021. 20
July 1, 1907, outstanding liabilities-----	21. 20
	<hr/> 24, 000. 00
July 1, 1907, balance available-----	<hr/> 24, 000. 00
Amount (estimated) required for completion of existing project-----	48, 473. 29

(b) *Mattituck Harbor*.—This harbor is a tidal inlet extending in a southerly direction from Long Island Sound to the village of Mattituck, Long Island. One mile above the mouth a tide milldam with gates has been built across the stream. The depth at the entrance, which is obstructed by a shifting sand bar, is from 1 to 2 feet; thence up to the milldam from 2 to 7 feet at low tide, and above the latter the depth is 6 feet at high tide.

The project adopted by the act of June 3, 1896, provides for a channel 7 feet deep at mean low water from the entrance to the dam and 7 feet deep at mean high water above the dam to the village, the width to be 80 feet, except near the mouth, where it is increased to 100 feet; the entrance channel to be protected by two parallel jetties, 400 feet apart, extending out to the 9-foot curve. Estimated cost, \$83,000.

Up to June 30, 1907, \$28,529.73 had been expended on the project, all for improvement.

About 34 per cent of the work proposed under the project has been completed, resulting in the completion of the west jetty to full projected section for a length of 680 feet, extending out to the 10-foot curve; the east jetty to full projected section for a length of 775 feet, extending out to the 7-foot curve; and in dredging a channel at the entrance 7 feet deep at mean low water, 60 feet wide, and about 800 feet long. The jetties serve to some extent in fixing the channel entrance, but navigation will not be materially benefited until the channel has been deepened by dredging.

The available funds are to be applied to continuing the improvement and to maintenance.

The maximum draft that could be carried June 30, 1907, over the shoalest part of the channel at mean low water is estimated at about 1 foot. The head of navigation is at the village of Mattituck. The total length of navigable channel from Long Island Sound to Mattituck is about 2½ miles. The range of tide outside the entrance is 4.8 feet and below the milldam 2.2 feet.

The commerce consists principally of coal, building materials, fruits, farm produce, and general merchandise, and amounted to 56,602 tons, valued at \$2,041,766, in 1904.

No change in freight rates has yet resulted, the work not being sufficiently advanced.

For detailed description of this work see Annual Reports of the Chief of Engineers for 1891, page 843, and 1897, page 1095.

July 1, 1906, balance unexpended.....	\$10,045.32
Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	40,000.00
	<hr/> 50,045.32
June 30, 1907, amount expended during fiscal year, for works of improvement.....	3,575.05
	<hr/>
July 1, 1907, balance unexpended.....	46,470.27
July 1, 1907, outstanding liabilities.....	4,758.92
	<hr/>
July 1, 1907, balance available.....	41,711.35
	<hr/>
July 1, 1907, amount covered by uncompleted contracts.....	1,306.96
Amount (estimated) required for completion of existing project....	8,000.00

(c) *Huntington Harbor*.—This harbor is a narrow tidal estuary extending inland from Huntington Bay, Long Island, in a southerly direction for a distance of about 2 miles.

Before improvement it had a natural available depth of nearly 8 feet, mean low water, for a stretch of  $1\frac{1}{4}$  miles from the entrance southward, thence gradually decreasing to zero toward the head of the harbor.

In 1872 the first project was adopted, under which in 1873 a shoal at the harbor entrance was removed and a channel 2,200 feet long, 130 to 150 feet wide, and 8 feet deep at mean low water was dredged up to the town landings at a total cost of \$22,500. In 1884 this channel had completely filled up.

The present project, adopted September 19, 1890, provides for dredging and maintaining a channel 8 feet deep at mean low water and 100 feet wide up to the upper wharves, to be protected by piling, if necessary. Estimated cost, \$32,000.

Up to June 30, 1907, \$34,521.60 had been expended on this project; of this amount, \$5,032.54 was for maintenance.

The present project is completed, except as to the dredging or pile construction necessary to maintain the channel. For purposes of maintenance the channel has been dredged 200 feet wide in lieu of pile protection. The channel has deteriorated somewhat.

The available funds are to be applied to maintenance.

The maximum draft that could be carried June 30, 1907, over the shoalest part of the channel is estimated at about 7 feet at mean low water. Mean range of tide, 7.2 feet. The head of navigation is at a causeway about one-third of a mile above Town dock. The total length of navigable channel from Huntington Bay to the causeway is about 2 miles.

The commerce of this harbor consists mainly of coal, farm produce, building material, and miscellaneous merchandise, and amounted to 23,584 tons, valued at \$473,109, in 1897; to 46,500 tons, valued at \$605,000, in 1899; to 45,600 tons, valued at \$768,000, in 1900; to 52,000 tons, valued at \$875,800, in 1901; to 66,000 tons, valued at \$1,086,000, in 1903; to 94,950 tons, valued at \$2,818,250, in 1904; and to 105,212 tons, valued at \$2,774,850, in 1906.

The effect of the improvement has probably been to reduce the freight rates since the channel has been deepened.

For detailed description see Report of the Chief of Engineers for 1897, page 1100. A sketch of the upper part of the harbor is printed in the Annual Report for 1904, page 1023.

July 1, 1906, balance unexpended.....	\$2, 064. 72
Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	3, 500. 00
	5, 564. 72
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	2, 086. 32
July 1, 1907, balance unexpended.....	3, 478. 40

(d) *Glencove Harbor*.—This harbor is a small tidal inlet on the east side of Hempstead Harbor, Long Island. Its channel is about 2 feet deep at mean low water and a bar at the entrance has a foot less of depth. Before improvement vessels waiting for tides to enter the harbor were exposed to storms from the north and northwest.

The existing project, adopted August 11, 1888, and revised June 22, 1895, provides for the construction of a breakwater in Hempstead Harbor, extending from the northwest corner of Glencove dock west-southwesterly toward Motts Point, so as to shelter the anchorage outside of Glencove Harbor. The breakwater is to have a length of 2,000 feet and to be built to a height of 3 feet above high water, with a top width of 5 feet. Estimated cost, \$135,000.

Up to June 30, 1907, \$72,000 had been expended on the project, all for improvement.

About 53 per cent of the work contemplated under the project has been completed and has resulted in building 1,564 feet of the breakwater to full projected section.

The present length of breakwater appears to afford sufficient protection to vessels seeking shelter from storms in this vicinity, and its further extension therefore seems to be unnecessary.

The maximum depth in the anchorage behind the breakwater is estimated at 21 feet at mean low water. Mean range of tides, 7.7 feet. The head of navigation is at the southern extremity of Hempstead Harbor, about 3½ miles from the breakwater.

The commerce of the harbor is chiefly coal, and amounted to 8,549 tons, valued at \$40,515, in 1904; and to 7,062 tons, valued at \$18,000, in 1906.

This improvement has no immediate effect on freight rates.

For details of improvement see Report of the Chief of Engineers for 1897, page 1103. A map is printed in Report of the Chief of Engineers for 1889, page 728.

July 1, 1906, balance unexpended.....	\$169. 72
June 30, 1907, amount expended during fiscal year, for works of improvement.....	169. 72
Amount (estimated) required for completion of existing project.....	63, 000. 00

(e) *Flushing Bay*.—Flushing Bay is on the north shore of Long Island, about 14 miles by water from the Battery, New York City. The bay is about 1 mile wide and 2 miles long, the depth in the original channel being not much greater than elsewhere in the bay. Before improvement the controlling depth up to Flushing was 3.9 feet at mean low water.

The existing project, adopted March 3, 1879, and modified September 19, 1888, and June 9, 1891, provides for building a dike 4,663 feet long on the west side of the channel to protect it from filling and for making and maintaining a channel 6 feet deep at mean low water up to the lower bridge at Flushing. Estimated cost, \$173,500.

Up to June 30, 1907, \$133,462.16 had been expended on the project. During progress of work it was repeatedly necessary to redredge some parts of the channel, so that it is not possible to state exactly what part of above sum was used for maintenance. The expenditure to June 30, 1907, for maintenance is estimated at \$10,462.16.

About 71 per cent of the work proposed under the project has been completed, and has resulted in a channel 6 feet deep at mean low water, but of insufficient width for the present needs of the locality; and in the construction of a dike 4,663 feet long. The whole of the dike is in bad condition, and all of the outer end, 1,606 feet long, with the exception of a few scattering piles and stones, has been carried away by storms and ice. Dike construction was discontinued in 1891.

The available funds are to be applied to making such slight changes in the dike as may be necessary to make it less of an obstruction to navigation, to continuing the improvement, and to maintenance.

The maximum draft that could be carried June 30, 1907, from East River to just beyond the Main Street Railroad Bridge at mean low water is estimated at 6 feet. Mean range of tides, 7.1 feet. The head of navigation is 1 mile above Strongs causeway. The total length of the navigable channel is about  $5\frac{1}{2}$  miles.

The commerce consists chiefly of coal, building materials, dye-woods, and miscellaneous merchandise, and amounted to 163,395 tons, valued at \$1,449,438, in 1897; to 158,755 tons, valued at \$1,534,937, in 1899; to 200,473 tons, valued at \$4,196,406, in 1901; to 186,000 tons, valued at \$1,613,100, in 1902; to 110,100 tons, valued at \$960,750, in 1903; to 142,996 tons, valued at \$2,599,488, in 1904; to 142,274 tons, valued at \$2,656,650, in 1905, and to 273,312 tons, valued at \$3,937,444, in 1907.

The effect of the improvement has probably been to reduce the freight rates since the channel has been deepened.

For detailed description of improvement see Report of the Chief of Engineers for 1897, page 1106. A map is printed in the Report of the Chief of Engineers for 1903, page 868.

Report of the examination authorized by the river and harbor act approved June 13, 1902, is printed in Report of the Chief of Engineers for 1905, page 990:

July 1, 1906, balance unexpended.....	\$1, 944. 64
Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	27, 000. 00
	<hr/> 28, 944. 64
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	406. 80
	<hr/> 28, 537. 84
July 1, 1907, balance unexpended.....	28, 537. 84
July 1, 1907, outstanding liabilities.....	50. 00
	<hr/> 28, 487. 84
July 1, 1907, balance available.....	<hr/> 21, 962. 16
Amount (estimated) required for completion of existing project.....	

(f) *Canarsie Bay*.—This bay forms the northwest part of Jamaica Bay at Canarsie Landing. The original depth from the landing to Big channel was 4.2 feet and to Island channel 1.3 feet at mean low water.



The project for this improvement, adopted June 14, 1880, and subsequently enlarged in 1889 and 1896, provides for the construction of two dikes and dredging between them where necessary to secure a channel 100 to 150 feet wide and 6 feet deep, connecting the steamboat dock at Canarsie with Big channel, Jamaica Bay; also for a channel 4 feet deep and about 50 feet wide, running in a south-westerly direction from Canarsie Landing to Island channel, and for a channel 5 feet deep and 50 feet wide, running in a northeasterly direction to Gophel channel. Estimated cost, \$88,000.

Up to June 30, 1907, \$72,565.72 had been expended on the project; of this amount, \$2,693.36 was for maintenance.

The work of improvement under the project has been completed. The dredged channels have deteriorated somewhat, and the dikes are in poor condition. The channel connecting the steamboat dock with Big channel has, under a contract completed June 17, 1907, been restored to its projected depth of 6 feet at mean low water and width of about 125 feet.

The available funds are to be applied to maintenance.

The maximum draft that could be carried June 30, 1907, over the shoalest part of the channel at mean low water is estimated at 6 feet in the main channel, 2½ feet in the West Branch, and 3 feet in the East Branch. Mean range of tides, 4.7 feet. The total length of navigable channel is about 1 mile. The head of navigation is at Canarsie Landing.

The commerce of Canarsie is mainly in building materials, fertilizers, fish, and coal, and amounted to 50,000 tons, valued at \$427,375, in 1896; to 450,000 tons, valued at \$2,000,000, in 1901; to 124,594 tons, valued at \$1,861,008, in 1904; and to 95,460 tons, valued at \$1,714,022, in 1905.

The commerce of Canarsie Bay has been greatly benefited by the improvement and freight rates reduced.

Details as to this improvement may be found in Report of the Chief of Engineers for 1897, page 1114. A sketch of Canarsie Bay is printed in Report of the Chief of Engineers for 1904, page 1026.

July 1, 1906, balance unexpended.....	\$2, 546. 04
Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	4, 000. 00
	<hr/> 6, 546. 04
June 30, 1907, amount expended during fiscal year, for maintenance of improvement .....	2, 611. 76
July 1, 1907, balance unexpended.....	3, 934. 28
July 1, 1907, outstanding liabilities.....	139. 00
	<hr/> 3, 795. 28
July 1, 1907, balance available.....	3, 795. 28

(g) *Sag Harbor*.—This harbor lies on the northern shore of Long Island, about 24 miles west of Montauk Point. It is a small bay, sheltered by Long Island on the south and west, and partly by Shelter Island on the north, and is open to the northeasterly storms.

The project adopted June 13, 1902, consists in constructing a break-water 3,180 feet long from Conklin Point, at an estimated cost of \$71,000.

Up to June 30, 1907, \$31,388.81 had been expended on the project, all for improvement. There was received on bond of failing contractor \$2,296.

About 57 per cent of the work proposed under the project has been completed. The breakwater has been built to its full projected section for a distance of 2,050 feet and affords protection to boats of light draft.

The available funds are to be applied toward completing the improvement.

The maximum draft that can be carried, June 30, 1907, through the harbor up to the wharves is about 12 feet at mean low water. The mean range of tide is 2.5 feet. The head of navigation is located in Sag Harbor Cove, about 1 mile above the town wharves. The total length of navigable channel from these wharves to the deep water of Gardiners Bay is about 5 miles. When completed, the breakwater will afford protection to an area approximately one-half mile long by three-eighths of a mile wide.

The commerce of the harbor, mainly in general merchandise and fruits and farm products, amounted to 3,454 tons, valued at \$187,015, in 1904; to 18,771 tons, valued at \$401,989, in 1905; and to 19,041 tons, valued at \$237,275, in 1906.

The work is not far enough advanced to affect freight rates.

For detailed report see Report of the Chief of Engineers for 1900, page 1451. A sketch of the harbor is printed in the Report of the Chief of Engineers for 1903, page 870.

July 1, 1906, balance unexpended	\$7, 476. 34
Amount allotted from appropriation by river and harbor act approved March 2, 1907	26, 500. 00
	<hr/> 33, 976. 34
June 30, 1907, amount expended during fiscal year, for works of improvement	7, 069. 15
July 1, 1907, balance unexpended	<hr/> 26, 907. 19
Amount (estimated) required for completion of existing project	<hr/> 15, 000. 00

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July 1, 1906, balance unexpended	\$33, 973. 40
Amount appropriated by river and harbor act approved March 2, 1907	125, 000. 00
	<hr/> 158, 973. 40
June 30, 1907, amount expended during fiscal year:	
For works of improvement	\$18, 119. 43
For maintenance of improvement	7, 504. 88
	<hr/> 25, 624. 31
July 1, 1907, balance unexpended	<hr/> 133, 349. 18
July 1, 1907, outstanding liabilities	4, 969. 12
July 1, 1907, balance available	<hr/> 128, 380. 06
July 1, 1907, amount covered by uncompleted contracts	1, 306. 96
Amount (estimated) required for completion of existing project	<hr/> 156, 435. 45

(See Appendix E 6.)

7. *East River and Hell Gate, New York.*—East River, a tidal strait separating New York City from Long Island, extends from the Battery to Throgs Neck, a distance of about 16 miles. In its original

condition it was obstructed by rocks and reefs, especially in the part known as Hell Gate.

The improvement of this waterway was commenced in 1852, under a project prepared in 1848, which contemplated the removal of rocks at Hell Gate and Diamond reef. The amount expended under this project was \$33,861.59.

The existing project for improvement, adopted in 1868 and modified in 1870, 1874, 1884, 1889, 1891, and 1899, provides for the removal of rocky obstructions from the channel between the Battery and Baretto Point to depths varying from 18 to 26 feet, and for the construction of sea walls and dikes where necessary to guide the tidal currents. The cost of the work was estimated at \$5,639,120.

Up to June 30, 1907, \$4,781,794.60 had been expended on the present project; of this amount \$98.02 was for maintenance. There was received from sales of condemned property \$1,334.25.

About 85 per cent of the work proposed under the present project has been completed and has resulted in the removal to the contemplated depths of Diamond reef off Governors Island; Coenties reef, off Coenties slip; Third street reef; Pilgrim rock, off Twentieth street; Charlotte rock, off Hunters Point; Man-o'-War rock, off Thirty-ninth street; Hallets Point, Ways reef, Shell Drake, and Scaly rock, in Hell Gate; reef at Middle Ground, off Sunken Meadow; North Brother Island reef; reef off Baretto Point; and in the partial removal of Battery reef; reef on South Ferry slips; Shell reef, off Tenth to Nineteenth streets; Ferry reef, off Thirty-fourth street; Middle reef (including Flood rock, Gridiron, Hen and Chickens, and Negro Heads), in Hell Gate; Frying Pan, and Pot rock, in Hell Gate.

The available funds are to be applied to making a resurvey of such part of the present project as may be necessary, including any ledge or ledges of rock near to the westerly shore, in completing the removal of Pot rock, and in removing parts of Frying Pan, Middle reef, Shell reef, and Battery and South Ferry reefs.

The maximum draft that could be carried at mean low water June 30, 1907, through the main channel from the Battery to Long Island Sound is estimated at 26 feet. The length of this waterway is about 16 miles. The range of tide south of Hell Gate is from  $4\frac{1}{2}$  to 5 feet, and east of it from 5 to 7 feet.

The traffic in East River is very great, and is intimately connected with that of New York Harbor proper. It is impracticable to show what proportion belongs to East River, especially as the heaviest coastwise traffic is carried on in vessels which do not enter or clear at the custom-house.

The improvement of the river has been of great benefit to navigation, but since most of the freight carried by the vessels using it is not local its effect on freight rates can not be determined.

Detailed description of this improvement is printed in the Reports of the Chief of Engineers for 1868, page 741; for 1874, Part 2, page 164, and for 1897, page 1026.

July 1, 1906, balance unexpended.....	\$160,254.58
Amount appropriated by river and harbor act approved March 2, 1907.....	250,000.00
	<hr/> 410,254.58
June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$7,275.46
For maintenance of improvement.....	98.02
	<hr/> 7,373.48
July 1, 1907, balance unexpended.....	402,881.10
July 1, 1907, outstanding liabilities.....	187.50
	<hr/> 402,693.60
July 1, 1907, balance available.....	<hr/> 455,876.57

Amount (estimated) required for completion of existing project... 455,876.57  
 (See Appendix E 7.)

8. *Harlem River, New York.*—The Harlem River and Spuyten Duyvil Creek, both included in the improvement, are two waterways which join at Kingsbridge, N. Y., and separate Manhattan Island from the mainland. The narrow channel at their junction was obstructed by a ledge of rocks awash at low tide.

Before improvement the Harlem River had an available depth of 10 feet at mean low water from the East River to Morris dock, except at Highbridge, where it was only 6 feet deep. From Morris dock to Fordham Landing there was a crooked channel 7 feet deep, and above the latter place the river could be used only by the smallest class of vessels. Spuyten Duyvil Creek, from Kingsbridge to the Hudson, had a depth of 4 feet.

The original project for improvement, adopted in 1874, provided for the removal of old bridge piers, Candle Factory reef, and bowlders at various places near the East River to a depth of 12 feet, the cost of the work being estimated at \$167,875.56. In furtherance of this project \$21,000 was expended.

The existing project, adopted June 18, 1878, and modified October 7, 1886, provides for a continuous channel 400 feet wide and 15 feet deep from the East River to the Hudson River, except about 1,300 feet north of Highbridge, where the width was made 354 feet, and at the rock cut through Dyckmans Meadow, where the width was reduced to 350 feet and the depth increased to 18 feet. Estimated cost, \$2,700,000.

On June 30, 1907, \$1,397,544.26 had been expended on the present project, all for improvement. About 52 per cent of the work proposed under the present project has been completed, and has resulted in making a channel 150 to 400 feet wide and 15 feet deep at mean low water from the Hudson River to the East River. From McCombs Dam bridge to the East River the width varies from 150 to 400 feet. At and near the Hudson River it is 400 feet wide.

The available funds are to be applied to continuing the improvement by widening the 150-foot channel, removing rocky obstructions at McCombs Dam bridge, and removing shoals at and between Second and Third avenue bridges.

The maximum draft that could be carried June 30, 1907, through the channel from East River to Hudson River at mean low water is estimated at 15 feet. The range of tides in Harlem River varies from 5.5 feet at Third Avenue Bridge to 3.8 feet at the mouth of

Spuyten Duyvil Creek. The least width of the channel was about 150 feet, except in places where shoaling has probably narrowed it somewhat. The total length of the waterway is about 8 miles.

The commerce of this river, which is general in character, amounted to 7,533,594 tons, valued at \$203,707,376, in 1895; to 6,910,386 tons, valued at \$282,186,100, in 1903; to 9,130,763 tons, valued at \$231,384,004, in 1904; to 9,998,021 tons, valued at \$270,210,309, in 1905, and to 11,385,649 tons, valued at \$104,359,757, in 1906.

The greater part of this is handled by the New York, New Haven and Hartford Railroad Company, principally on the lower part of the river, and therefore can not be considered as bearing on the general improvement.

The effect of the improvement, according to the best information available, is that some reduction has been made in freight rates, but the principal benefit derived has been in the way of increased facilities for handling shipments, which make a material saving in the cost of transportation.

Detailed description of this improvement is printed in Reports of the Chief of Engineers for 1887, page 665, and 1897, page 1019.

July 1, 1906, balance unexpended.....	\$62, 448. 09
Amount appropriated by river and harbor act approved March 2, 1907 .....	150, 000. 00
	<hr/> 212, 448. 09
June 30, 1907, amount expended during fiscal year, for works of improvement .....	64, 992. 35
July 1, 1907, balance unexpended.....	147, 455. 74
July 1, 1907, outstanding liabilities.....	6, 142. 98
	<hr/> 141, 312. 76
Amount (estimated) required for completion of existing project...	1, 155, 000. 00
(See Appendix E 8.)	

9. *Newtown Creek, New York.*—This creek, an inlet of the East River, extending inland between Kings and Queens counties, N. Y., for a distance of about 4 miles, had a natural depth varying from 12½ feet at the mouth to 4 feet at the head of navigation.

The original project, adopted in 1880 and modified in 1884, provided for a channel 240 feet wide and 21 feet deep from the mouth to the Vernon Avenue Bridge; thence to the head of navigation on both branches for channels decreasing from 175 to 100 feet in width and from 18 to 10 feet in depth. The cost of the work was estimated at \$255,500. In carrying out this project \$197,500 was expended.

The existing project, adopted June 3, 1896, is to secure a uniform channel, 125 feet wide and 18 feet deep, from the East River to the head of navigation at Metropolitan avenue, at an estimated cost of \$450,000. This estimate was subsequently reduced to \$213,000.

Up to June 30, 1907, \$218,365.79 had been expended on the project. Of this amount, \$19,756.33 was for maintenance.

About 93 per cent of the work proposed under the present project has been completed, resulting in a channel of the projected width and depth, with the exception of some widening at the entrance and the removal of bowlders near the mouth of the creek. The dredged channel has deteriorated to a considerable extent.

The available funds are to be applied to completing the improvement.

The maximum draft that could be carried over the shoalest part of the channel June 30, 1907, at mean low water, is estimated at 17 feet. The mean range of tides is about 4½ feet. The total length of navigable channel is about 4 miles. The head of navigation in each branch is at the Metropolitan Avenue bridges.

The commerce, consisting chiefly of coal, building materials, oil, ores, general merchandise, etc., amounted to 2,675,025 tons, valued at \$90,535,640, in 1903; to 3,771,726 tons, valued at \$108,313,377, in 1904; to 3,428,404 tons, valued at \$130,812,974, in 1905; and to 2,803,380 tons, valued at \$214,714,751, in 1906.

Freight rates have been greatly reduced as a result of this improvement.

Detailed descriptions of this improvement are printed in the Reports of the Chief of Engineers for 1896, page 760, and 1900, page 1411. A sketch of the locality is printed in Report of the Chief of Engineers for 1904, page 1034.

July 1, 1906, balance unexpended.....	\$4, 790. 54
Amount appropriated by river and harbor act approved March 2, 1907 -	5, 000. 00
Amount appropriated by sundry civil act approved March 4, 1907----	15, 000. 00

24, 790. 54

June 30, 1907, amount expended during fiscal year, for maintenance of improvement .....	4, 756. 33
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July 1, 1907, balance unexpended.....	20,034. 21
July 1, 1907, outstanding liabilities.....	34.21

July 1, 1907, balance available.....	20, 000.00
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(See Appendix E 9.)

10. *Browns Creek, New York.*—This is a narrow stream which empties into Great South Bay, Long Island, near Browns Point. It had originally a depth of from 1 to 3 feet at low water, a bar at the mouth having less than 1 foot.

The project for improvement, adopted September 19, 1890, provides for a channel 100 feet wide and 4 feet deep, to extend from deep water in the bay up to Sayville highway bridge, and to be protected at the entrance by jetties on both sides. Estimated cost, \$46,000.

Up to June 30, 1907, \$31,000 had been expended on the project, of which amount \$6,000 was for maintenance.

About 54 per cent of the work proposed under the project has been completed, resulting in the building of two jetties at the entrance and in the dredging of a channel 100 feet wide and 4 feet deep at mean low water for a distance of 3,200 feet from the entrance. Because of shoaling this dredged channel was redredged in 1905 to 4 feet depth at mean low water for a distance of about 1,200 feet from the end of the jetties.

There is now an available channel about 100 feet wide and 3 to 4 feet deep at mean low water for a distance of 3,200 feet from the entrance. Above this the channel remains in its original condition.

The west jetty is 492 feet long and the east jetty 438 feet long, both with top width of 3 feet at 1 foot above high water, and both partly covered at the shore end by accretion. They are in bad condition.

The available funds are to be applied to continuing the improvement.

The maximum draft that could be carried over the shoalest part of the dredged channel at mean low water June 30, 1907, is estimated at 3 feet; mean range of tides, 1 foot. The head of navigation is at the Sayville highway bridge, about  $1\frac{1}{2}$  miles from the mouth.

The fishing people in this locality have been benefited by the improvement to the extent of providing them with a harbor of refuge for small boats.

Because of rapid deterioration, due mainly to the inflow of mud from the marshes bounding the channel, \$6,000 has already been expended in redredging, and the jetties, built only to about one-third of their projected lengths, are in a very bad condition.

The total cost of completing the project will be much greater than the original estimate, and if the channel, which is now only 3,200 feet long and requires redredging, is extended upstream, the expenditure for maintenance will increase proportionately.

Considering the limited number of vessels using this creek for transportation purposes, the cost of improving and maintaining the entire length of the creek to Sayville, and completing the breakwaters as projected, would be out of proportion to the benefits to be derived therefrom. It is therefore recommended that future appropriations be made, not for extending the improvement, but only for maintaining the present dredged channel.

The commerce consists mainly of coal, building materials, and fish, and amounted to 10,700 tons, valued at \$213,800, in 1898; to 11,642 tons, valued at \$251,350, in 1899; to 17,025 tons, valued at \$454,500, in 1901; to 17,630 tons, valued at \$299,300, in 1902; to 20,380 tons, valued at \$609,450, in 1903; to 24,000 tons, valued at \$807,075, in 1904; to 51,675 tons, valued at \$1,811,195, in 1905; and to 29,675 tons, valued at \$983,880, in 1906.

Up to the present time the improvement has resulted in making a harbor of refuge for fishing boats, and has had no appreciable effect on freight rates.

Details in reference to this work appear in Reports of the Chief of Engineers for 1897, page 1111, and for 1900, page 1417. A sketch of the creek is printed in Report of the Chief of Engineers for 1894, page 710.

Amount appropriated by river and harbor act approved March 2, 1907.	\$5, 000. 00
July 1, 1907, balance unexpended.	5, 000. 00
Amount (estimated) required for completion of existing project.	16, 000. 00

(See Appendix E 10.)

*11. Great South Bay, New York.*—The first project, adopted September 19, 1890, provided for the improvement of the Patchogue River, a small inlet extending from Great South Bay, Long Island, to the village of Patchogue. This stream had, before improvement, a depth of 2 feet. The project provided for a channel about 5,000 feet long, 60 feet wide, and 6 feet deep, to be protected at its mouth against westerly storms by a jetty 1,700 feet long. Estimated cost, \$40,000. On June 30, 1902, there had been expended on this work \$40,000, and the project was completed.

The present project, adopted June 13, 1902, provides for dredging a channel from Fire Island Inlet, which connects Great South Bay with the ocean, to Patchogue, on Patchogue River. From the inlet to the central basin in Great South Bay the channel is to be 10 feet deep at mean low water and 200 feet wide. From the central basin to Patchogue the channel is to be 8 feet deep and 100 feet wide at mean low water. Estimated cost, \$66,000, and \$2,000 annually for maintenance.

Up to June 30, 1907, \$65,647.08 had been expended on the project, of which amount \$5,826.26 was for maintenance. About 91 per cent of the cost of the work contemplated under the present project has been completed, resulting in a channel 200 feet wide and 10 feet deep at mean low water in the bay, except at bars "A" and "B;" and in the completion of a channel 100 feet wide and 8 feet deep at mean low water in the river. Considerable shoaling has occurred in the latter.

The appropriation of March 2, 1907, is to be applied to maintaining the Patchogue River channel. The work of improvement in Great South Bay was stopped by injunction December 12, 1903, and again November 8, 1906, and the balance in hand from the appropriation of 1905 has been reserved for continuing the improvement if practicable.

As the work of improvement can not at present be brought to completion because of the injunction which is still in force, it is believed to be inadvisable to ask for an appropriation for dredging in the uncompleted channels until such time as the injunction may be removed.

The maximum draft that could be carried June 30, 1907, over the shoalest part of the channel from Fire Island Inlet to central basin was 8.5 feet and in Patchogue River 6 feet. Mean range of tides, 1 foot. The head of navigation in Patchogue River is at a fixed bridge at Division street, Patchogue. The total length of navigable channel from Fire Island Inlet to Patchogue is about  $17\frac{1}{2}$  miles and to Belleport 22 miles.

The commerce consists mainly of coal, lumber, and fish. It amounted to 255,200 tons, valued at \$3,702,000, in 1898; to 266,800 tons, valued at \$3,808,500, in 1899; to 274,100 tons, valued at \$3,919,000, in 1900; to 281,300 tons, valued at \$4,025,000, in 1901; to 257,500 tons, valued at \$4,000,000, in 1902; to 258,500 tons, valued at \$3,995,000, in 1903; to 257,879 tons, valued at \$4,037,130, in 1904; to 224,526 tons, valued at \$3,871,850, in 1905, and to 232,500 tons, valued at \$4,014,000, in 1906.

The effect of the improvement has probably been to reduce freight rates since the channel has been deepened.

For details as to improvement see Patchogue River, Reports of the Chief of Engineers for 1897, page 1108; for 1901, page 1249, and for 1903, page 134. A sketch is printed in Report of the Chief of Engineers for 1903, page 876.



July 1, 1906, balance unexpended-----	\$8, 179. 18
Amount appropriated by river and harbor act approved March 2, 1907-----	2, 000. 00
	<hr/> 10, 179. 18
June 30, 1907, amount expended during fiscal year, for maintenance of improvement-----	5, 826. 26
	<hr/> 4, 352. 92
July 1, 1907, balance unexpended-----	4, 352. 92
July 1, 1907, outstanding liabilities-----	549. 70
	<hr/> 3, 803. 22
July 1, 1907, balance available-----	3, 803. 22
	<hr/>
July 1, 1907, amount covered by uncompleted contracts-----	1, 503. 03
Amount (estimated) required for completion of existing project-----	1, 826. 26

(See Appendix E 11.)

12. *Hudson River, New York.*—The portion of this river which is now under improvement is the stretch beginning at the State dam at Troy and extending downstream to Coxsackie, a distance of 28 miles. In its natural condition the channel was narrow and crooked, with a navigable depth of 4 feet between the State dam and Albany, of 7½ feet between Albany and New Baltimore, of 11 feet between New Baltimore and Coxsackie, and of 12 feet or more below Coxsackie.

The original project for improvement, adopted in 1834, modified in 1852 and again in 1866, had for its object the securing of a navigable channel of sufficient width and 9 feet deep between Troy and Albany, and 11 feet deep between Albany and New Baltimore. In carrying out this work \$1,667,938 was expended.

The existing project, adopted July 13, 1892, and modified March 3, 1899, provides for a 12-foot channel 150 feet wide from the State dam to the foot of Jacob street, Troy; thence gradually increasing in width to 400 feet at the foot of Broadway, Troy; thence 400 feet wide to Coxsackie. This work was estimated to cost \$4,343,863. The act of 1907 authorized expenditure of \$5,000 in removing the bar and deepening the channel at the mouth of Schodack Creek.

On June 30, 1907, \$3,453,582.02 had been expended on the present project. Of this amount \$271,000.35 was for maintenance.

The proportion of the approved project accomplished on June 30, 1907, is about 73 per cent. The expenditures have resulted in an increase in the depth of the navigable channel on June 30, 1907, so that at mean low water the maximum depth that can be carried over the shoalest part of the channel under improvement below the Delaware and Hudson Company's bridge at Troy, N. Y., is 11 feet, for a width of channel of 140 feet, except through the draw spans of the bridges, where the width is contracted by the piers to about 80 feet in front of Albany and to 40 feet at Troy; a depth of 10 feet for a width of 80 feet from the Delaware and Hudson Company's bridge to within 900 feet of the State dam; 8.5 feet to the State dam, and 4.5 feet over the miter sill of the Sloop lock. The range of the tides in seasons of moderate rain varies from 2.55 feet at the State dam, 2.89 feet at Broadway, Troy, 2.84 feet at Albany, to 3.69 feet at Coxsackie, being an increase in elevation of high water of about 0.5 foot at Albany and at the foot of Broadway, Troy. The head of navigation for the tidal portion of the river is at the State dam, 153 miles from the Battery in New York City. The total length of navigable channel under improvement is 28 miles.

For results of previous tidal observations, reference is made to the Reports of the Chief of Engineers for 1897, page 998, and 1900, page 1490.

The commerce within the limits of the improvement consisted principally of lumber, grain, ice, building material, and fuel, and amounted to 3,310,628 tons, valued at \$66,866,160, in 1905, and to 3,325,360 tons, valued at \$75,664,747.91, in 1906.

The effect of the improvement has probably been to reduce freight rates.

The available balance will be applied to continuing the improvement and to maintenance.

July 1, 1906, balance unexpended.....	\$167, 903. 33
Amount appropriated by river and harbor act approved March 2, 1907.....	250, 000. 00
Receipts from sales.....	13. 75

417, 917. 08

June 30, 1907, amount expended during fiscal year:

For works of improvement.....	\$96, 546. 20
For maintenance of improvement.....	18, 127. 19
	114, 673. 39

July 1, 1907, balance unexpended.....	303, 243. 69
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July 1, 1907, outstanding liabilities.....	11, 276. 73
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July 1, 1907, balance available.....	291, 966. 96
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July 1, 1907, amount covered by uncompleted contracts.....	26, 858. 64
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Amount (estimated) required for completion of existing project.....	857, 056. 79
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(See Appendix E 12.)

13. *Saugerties Harbor, New York.*—Saugerties Harbor is the name applied to the mouth of Esopus Creek, which empties into the Hudson River from the west, about 100 miles above New York City, which creek is navigable at high water for a distance of about 6,000 feet from deep water in the Hudson River. Above the steamboat landing, which is a distance of about 4,500 feet from deep water, there is little traffic. The original depth over the bar was 3 feet at mean low water, which had been increased to 7 feet by dredging done by the State of New York in 1885-86.

The original project, which contemplated securing a permanent channel 7 feet deep at mean low water and 100 feet wide, at an estimated cost of \$52,000, was adopted in 1884, modified in 1887, and completed in 1892, with an expenditure of \$42,000. To June 30, 1902, \$15,000 had been expended for maintenance.

The existing project, which contemplates a channel 12 feet deep at mean low water and 200 feet wide from the channel of the Hudson River to the steamboat landing, at an estimated cost of \$44,685, with an annual expenditure of \$2,500 for maintenance, was adopted June 13, 1902.

The river and harbor act of March 3, 1905, authorizes the Chief of Engineers, upon application, to permit the extension of the channel from the point at which the present project terminates up to a point 600 feet below the dam in Esopus Creek, provided the plan of improvement is first submitted to and approved by him and that no part of the appropriation made by said act shall be expended therefor.

Up to June 30, 1907, \$27,559.39 had been expended on the present project; of this amount \$19,064.99 was for maintenance.

About 19 per cent of the work proposed under the present project has been completed and has resulted in the removal of a portion of a dangerous reef of rock, a continuation of Barclays Point, to a depth of 12 feet at mean low water, and in a channel 12 feet deep at mean low water, and 75 feet wide, except at a ledge of rock where the depth is only 10 feet and width 50 feet.

The expenditure for maintenance is mainly due to restoring the channel above the reef, where, owing to the breaking of the dam a short distance above the head of navigation in the summer of 1902 and the consequent release of a large quantity of mud and silt retained by it, the channel had been reduced in width and depth so as to be practically closed to the navigation of large boats, and the relief to navigation along the wharves on the north side of the channel, where extensive shoaling had taken place, apparently as the result of the removal of the rock off Barclays Point.

The available balance is to be applied to continuing the improvement and to maintenance.

The maximum draft at mean low water that could be carried June 30, 1907, is estimated at 10 feet, for a minimum width of 50 feet. The mean rise and fall of tides is about 4 feet. The head of navigation is at a point about 1,600 feet below the dam. The total length of navigable channel is about  $1\frac{1}{4}$  miles.

The commerce consists mainly of bluestone, coal, building material, and general merchandise, and amounted to 67,473 tons in 1901, 66,500 tons in 1902, 112,677 tons in 1903; 113,200 tons, valued at \$18,832,195, in 1904; 81,600 tons, valued at \$1,598,000, in 1905; and to 83,300 tons, valued at \$1,606,200, in 1906.

The effect of the improvement, according to the best information available, is to reduce freight rates during the season of navigation.

Details in reference to this work appear in Reports of the Chief of Engineers for 1895, page 910, and 1900, page 1518. A sketch is printed in Report of the Chief of Engineers for 1904, page 1046.

July 1, 1906, balance unexpended-----	\$4,567.08
Amount appropriated by river and harbor act approved March 2, 1907_	20,000.00
	<hr/> 24,567.08
June 30, 1907, amount expended during fiscal year:	
For works of improvement-----	\$3,162.55
For maintenance of improvement-----	963.92
	<hr/> 4,126.47
July 1, 1907, balance unexpended-----	20,440.61
	<hr/> 15,749.99
Amount (estimated) required for completion of existing project----	
(See Appendix E 13.)	

14. *Harbors at Rondout and Peekskill, N. Y.*—(a) *Rondout Harbor*.—This harbor is at the mouth of Rondout Creek, which empties into the Hudson River on its west shore, 90 miles above New York City. The creek, which is navigable to Eddyville, 3 miles from its mouth, was the most easterly section of the Delaware and Hudson Canal until that waterway was abandoned several years ago. The original depth before the improvement was begun, which was the result of work of private parties, was 7 feet at mean low water.

The original project, which contemplated securing a channel 14 feet deep at mean low water and 100 feet wide, at an estimated cost of \$172,500, was adopted June 10, 1872, and was completed in 1880 at a total cost of \$90,000. Since then the expenditure has been for maintenance.

Up to June 30, 1907, \$131,176.58 had been expended on the project. Of this amount \$41,176.58 was for maintenance since 1880.

The result of the above expenditure is a channel 13½ feet deep at mean low water and not less than 80 feet wide from deep water in the Hudson River to the westerly end of the dikes. At the entrance the channel is not less than 100 feet wide and 14 feet deep at mean low water.

The available balance is to be applied to maintenance.

The maximum draft that could be carried through the channel June 30, 1907, was 13½ feet at mean low water, with a least width of channel of about 80 feet. The mean rise and fall of tides is 4 feet. The head of navigation is at Eddyville. The total length of navigable channel is 3 miles.

The effect of the improvement has probably been to keep the freight rates down during the season of navigation.

The commerce, which is mainly fuel, bluestone, cements, and general merchandise, amounted to 1,460,000 tons, valued at \$41,065,000, in 1904; to 1,325,000 tons, valued at \$46,112,500, in 1905, and to 998,524 tons, valued at \$5,640,900, in 1906.

Detailed description of this improvement is printed in Reports of the Chief of Engineers for 1880, page 494, and for 1895, page 913. A sketch of the harbor is printed in Report of the Chief of Engineers for 1903, page 1884.

July 1, 1906, balance unexpended.....	\$9,797.19
Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	3,000.00
	<hr/>
	12,797.19
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	673.77
	<hr/>
July 1, 1907, balance unexpended.....	12,123.42

(b) *Peekskill Harbor*.—This harbor is an indentation on the eastern shore of the Hudson River, about 46 miles above New York City, and was a flat, about 3,500 feet wide, extending from the shore to the deep-water channel of the Hudson River, with a depth of water over it of about 5 feet at mean low water, except near the shore, where it was about 6 feet deep.

The original project for improvement, which provided for a dredged channel 10 feet deep at mean low water and 100 feet wide from deep water in the Hudson River north of the village to deep water south of it, following generally the contour of the shore, at an estimated cost of \$50,000, was adopted June 3, 1896, and was completed in 1899, at a cost of \$19,400.

Up to June 30, 1907, \$25,187.72 had been expended on the project; of this amount, \$5,787.72 was for maintenance.

There is now an available channel 10 feet deep at mean low water and about 100 feet wide from deep water in the Hudson River north of the village to the wharves, and thence to deep water in the Hudson

River south of the village, except in places along the wharf front where considerable shoaling has taken place.

The available funds are to be applied to maintenance.

The maximum draft that could be carried through the channel June 30, 1907, at mean low water is estimated at 8 feet. Mean range of tides is about 3 feet. The total length of channel is  $1\frac{1}{2}$  miles.

The commerce, which is mainly in general merchandise, building material, and fuel, amounted to 81,265 tons, estimated value \$3,751,985.61, in 1904; to 74,546 tons, valued at \$1,134,748, in 1905; and to 88,550 tons, valued at \$659,864, in 1906.

The effect of the improvement during the season of navigation is to lower freight rates.

Detailed description of this improvement is printed in Report of the Chief of Engineers for 1895, page 999, and for 1897, page 1016.

A sketch of the harbor is printed in Report of the Chief of Engineers for 1903, page 885.

July 1, 1906, balance unexpended.....	\$2, 407. 57
Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	3, 000. 00
	<hr/> 5, 407. 57
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	2, 095. 29
July 1, 1907, balance unexpended.....	<hr/> 3, 312. 28

#### CONSOLIDATED.

July 1, 1906, balance unexpended.....	\$12, 204. 76
Amount appropriated by river and harbor act approved March 2, 1907.....	6, 000. 00
	<hr/> 18, 204. 76
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	2, 769. 06
July 1, 1907, balance unexpended.....	<hr/> 15, 435. 70

(See Appendix E 14.)

15. *Wappinger Creek, New York.*—Wappinger Creek is a small stream, which empties into the Hudson River from the east about one-half mile below the village of New Hamburg, N. Y.; it is navigable from its mouth for a distance of about 2 miles to the works of the Dutchess Company, which are located just below the falls and at the head of navigation. The entrance to the creek is through a drawbridge over which passes the New York Central and Hudson River Railroad, with one opening of 26 feet clearance and about 4 feet clear head room at mean low water under fixed spans. The original depth in the channel did not exceed 6 feet, and the width varied from 25 to 75 feet.

The original project for improvement, which contemplated a channel 8 feet deep at mean low water and 80 feet wide, at an estimated cost of \$13,000, was adopted September 19, 1890, and was completed April 30, 1892.

Up to June 30, 1907, \$17,500 had been expended on the project; of this amount, \$4,500 was for maintenance.

The result of the expenditure has been to dredge a channel 8 feet deep at mean low water and 80 feet wide; but this channel has

shoaled to such an extent that the width has been reduced in places to about 30 feet and the depth to 7 feet or less.

The available balance is to be applied to maintenance.

The greatest draft that can be carried June 30, 1907, at mean low water, from deep water in the Hudson River to the head of navigation, is estimated at 7 feet with a minimum width of channel of 30 feet. The mean rise and fall of tides at the mouth of the creek is about 3.3 feet. The total length of navigable channel is about 2 miles.

The commerce, consisting principally of cotton goods, clothing, building material, fuel, etc., amounted to 56,927 tons, valued at \$7,955,975, in 1904; to 49,562 tons, valued at \$4,872,903, in 1905; and to 46,194 tons, valued at \$572,399, in 1906.

The traffic in the creek is mainly for the benefit of the print works at the head of navigation. Its effect is to reduce the freight rates.

Details in reference to this work appear in the Report of the Chief of Engineers for 1893, page 1024. A sketch is printed in the Report of the Chief of Engineers for 1904, page 1051.

July 1, 1906, balance unexpended.....	\$129. 83
Amount appropriated by river and harbor act approved March 2, 1907.....	3, 000. 00
	<hr/>
	3, 129. 83
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	129. 83
	<hr/>
July 1, 1907, balance unexpended.....	3, 000. 00

(See Appendix E 15.)

*16. Tarrytown Harbor, New York.*—This harbor is located on the east shore of Hudson River, about 28 miles above New York City, where the river is several miles wide. The channel is bordered on both sides by extensive flats, that on the east side measuring about three-eighths of a mile from the main wharf to the 12-foot depth in the river. The general depth in the harbor is about  $4\frac{1}{2}$  feet at mean low water. Two channels, with a depth of about 6 feet, lead up to the main wharf.

The plan for improvement adopted by the river and harbor act of March 3, 1905, provides for dredging a channel along the wharf front of the harbor and connecting it north and south with deep water in Hudson River, the said channel to have a depth of 12 feet, with a width of 150 feet along the wharf front and a width of 100 feet in the northerly and southerly connections with the Hudson River. The estimated cost of this work is \$26,000, increased in 1907 to \$35,491.68, and \$1,000 or \$2,000 biennially for maintenance.

Up to June 30, 1907, \$10,000 had been expended on this project, all in improvement. About 30 per cent of the work proposed under the project has been completed, resulting in a channel about 60 feet wide and 12 feet deep, at mean low water, from deep water in the Hudson River south of Tarrytown to within about 300 feet of the northerly (Husted's) dock in Tarrytown.

The available funds are to be applied to continuing the improvement. The original estimate for this work, as given in the Annual Report of the Chief of Engineers for 1900, page 1524, is for 152,222 cubic yards of material. This estimate has been so far checked as to determine that it was based upon actual prism contents of volume to be dredged to 12 feet. But in contracting for like work it has been

the practice to obtain proposals based upon measurement in scows, which has been found to exceed prism measurement by approximately 20 per cent, and also upon allowing material to be removed 1 foot below the prescribed depth.

In order, therefore, to complete the channel as adopted by the river and harbor act of March 3, 1905, it will be necessary to make an allowance of 30,444 cubic yards for scow measurement, and 23,486 cubic yards for dredging 1 foot below the projected depth of 12 feet at mean low water, or a total of 53,930 cubic yards, which, at 16 cents per cubic yard and 10 per cent for engineering, contingencies, etc., amounts to \$9,491.68, and the original estimate of \$26,000 (Annual Report of the Chief of Engineers for 1900, page 1524) is increased by this amount.

The allowance of 1 foot for overdepth in dredging has heretofore been made because it is impracticable for dredges to restrict excavation to the exact depths required. To insure the exact depth they would of necessity excavate to an increased depth, and if the additional material thereby removed were not paid for, the unit price would be proportionately higher.

The maximum draft that could be carried June 30, 1907, at mean low water, from deep water in the Hudson River south of Tarrytown to within about 300 feet of Husted's dock in Tarrytown is estimated at 12 feet, and from deep water in the Hudson River north of Tarrytown to the same wharf at 6 feet. Mean range of tides is about  $3\frac{1}{2}$  feet. The total length of projected channel is about  $1\frac{1}{2}$  miles, about three-eighths of a mile of which has a depth of about 12 feet at mean low water and width of 60 feet; the remainder of the channel has not yet been improved.

The improvement has not advanced far enough to affect freight rates.

The commerce, mainly in general merchandise, coal, and building materials, amounted to 71,201 tons, valued at \$1,830,092 in 1905, and to 79,714 tons, valued at \$384,979 in 1906.

Detailed description of this harbor is printed in Reports of the Chief of Engineers for 1889, page 800, and 1900, page 1520.

July 1, 1906, balance unexpended.....	\$4,200. 61
Amount appropriated by river and harbor act approved March 2, 1907.....	16,000. 00
	<hr/> 20,200. 61
June 30, 1907, amount expended during fiscal year, for works of improvement .....	4,200. 61
	<hr/> 16,000. 00
July 1, 1907, balance unexpended.....	16,000. 00
July 1, 1907, outstanding liabilities .....	90. 00
	<hr/> 15,910. 00
July 1, 1907, balance available.....	<hr/> 9,491. 68
Amount (estimated) required for completion of existing project.....	

(See Appendix E 16.)

*17. Coney Island channel, New York Harbor.*—This channel lies immediately south of Coney Island at the southwestern extremity of Long Island, New York, and is one of five channels which cross the bar that separates New York lower bay from the ocean. A channel 500 to 560 feet wide and 14 feet deep at mean low water was dredged in 1900, and in 1905 this channel was redredged to a width of 400

feet. When surveyed in 1906, the least depth on the western of two bars in the channel was about  $12\frac{1}{2}$  feet at mean low water and about 16 feet on the eastern bar.

The present project for improvement, adopted by the river and harbor act of March 2, 1907, provides for dredging a channel 20 feet deep at mean low water and 600 feet wide, with side slopes of 1 on 3 from deep water in the lower bay to deep water in the Atlantic Ocean at an estimated cost of \$168,300, and \$20,000 annually for maintenance.

Up to June 30, 1907, \$15.05 had been expended on this project for office expenses. The work of improvement had not been commenced at the close of the fiscal year.

The available funds are to be applied to completing the improvement and to maintenance.

- The maximum draft that could be carried over the shoalest part of the channel June 30, 1907, at mean low water is estimated at  $12\frac{1}{2}$  feet. The mean range of tides is about 4.6 feet. The total length of projected channel is about  $1\frac{1}{2}$  miles.

The commercial interests using this channel are those of the city of New York and other cities whose commerce passes Sandy Hook. It is impracticable to state what proportion of this commerce uses Coney Island channel.

A report upon the examination and survey of Coney Island channel and map of the locality are printed in House Document No. 442, Fifty-ninth Congress, second session.

Amount appropriated by river and harbor act approved March 2, 1907 .....	\$188, 300. 00
June 30, 1907, amount expended during fiscal year, for works of improvement.....	15. 05
July 1, 1907, balance unexpended.....	188, 284. 95

(See Appendix E 17.)

18. *Removing sunken vessels or craft obstructing or endangering navigation.*—(a) *Wreck of unknown sloop in Great South Bay, Long Island, New York.*—This wreck was sunk in Great South Bay about 1 mile in a south-southeasterly direction from Sampawams Point. It was reported to the Department June 29, 1906, and an allotment of \$375 for its removal was made July 2, 1906. Its removal was completed October 15, 1906, at a total cost of \$375.

(b) *Wreck of schooner Eaglet in Hudson River, New York, N. Y.*—This wreck was sunk about midstream in Hudson River about opposite Sixty-fifth street, Manhattan, New York City. It was reported to the Department July 26, 1906, and an allotment of \$1,000 for its removal was made July 30, 1906. Its removal was completed August 12, 1906, at a total cost of \$856.37.

(c) *Pieces of wreckage of tugboat Sharp and barge Coggeshall in Hudson River, New York.*—This wreckage was found in the channel near Abbey Cut July 23, 1906, and was immediately removed at a total cost of \$125. The removal was reported to the Department July 28, 1906, and an allotment of \$125 to defray the expenses thereof was made July 31, 1906.

(d) *Wreck of unknown pile driver in East River, New York, N. Y.*—This wreck was sunk in East River, off the Battery, and was



reported August 1, 1905, as abandoned. Immediate steps were taken to cause its removal, but when the wrecking company, which proposed to do the work for \$350, undertook to remove it, no trace of the obstruction could be found. The wreck was reported to the Department July 19, 1906, and \$100 was allotted August 4, 1906, to defray the actual and necessary expenses incidental to its removal.

(e) *Wreck of canal boat Thomas Tryon in Hempstead Harbor, Long Island, New York.*—This wreck was sunk on May 24, 1906, at the mouth of Glencove Creek, Hempstead Harbor. It was reported to the Department November 1, 1906, and an allotment of \$200 for its removal was made November 6, 1906. A further allotment of \$200 for completing the removal was made December 13, 1906. The work was completed December 24, 1906, at a total cost of \$400.

(f) *Wreck of canal boat Malvina St. Clair in East River, New York.*—This derelict was picked up in East River off Seventy-second street, Manhattan, New York, November 1, 1906. It was removed by the Baxter Wrecking Company November 3, 1906, and deposited on that company's property in Weehawken, N. J., at a total cost of \$190. Report was submitted to the Department November 12, 1906, and an allotment for this amount to pay the cost of removal was made November 14, 1906.

(g) *Wreck of steamer Governor in Rockaway Inlet, Long Island, New York.*—This wreck was sunk in Rockaway Inlet about seven years ago during a storm, and was, until reported as endangering navigation, buried in the sand bars which form at the entrance to Jamaica Bay. It was reported to the Department November 20, 1906, and an allotment of \$5,000 for its removal was made November 27, 1906. Its removal was completed February 23, 1907, at a total cost of \$1,625.

(h) *Wreck of barge Charles G. Hill in Hudson River, New York.*—This wreck was sunk in Hudson River, opposite Marlboro, N. Y. It was removed December 14, 1906, at a total cost of \$121.40. Report was submitted to the Department December 17, 1906, and an allotment of this amount to pay the cost of removal was made December 21, 1906. Subsequently bids were opened for the sale of wreckage recovered from the barge, and the proceeds of the sale, amounting to \$15, were forwarded to the United States Treasury January 17, 1907. The net cost of removal amounted, therefore, to \$106.40.

(i) *Wreck of tugboat Sea Wall in Harlem River, New York.*—This wreck was sunk in Harlem River near the foot of One hundred and twenty-ninth street, Manhattan, New York, outside of the harbor lines, in from 8 to 12 feet of water at low water. It was reported to the Department January 9, 1907, and an allotment of \$160 for its removal was made January 11, 1907. Removal was completed January 14, 1907, at a total cost of \$63.70.

(j) *Wreck of ferryboat Paterson in Hudson River, New York.*—This wreck was sunk in Hudson River December 29, 1906, about opposite and 1,000 feet distant from pier 47, Manhattan, New York, N. Y. Report was submitted to the Department January 18, 1907, and an allotment of \$200 for the purpose of making an examination of the sunken boat was made January 22, 1907. Further allotments

were made February 1, 1907, of \$2,500, and April 3, 1907, of \$500, for removing the obstruction.

The ferryboat was not abandoned by the owners, the Erie Railroad Company, until January 25, 1907, and for this reason proposals for removing the wreck were not invited until January 26, 1907, bids to be opened January 30, 1907.

The contract was dated January 31, 1907, and required the removal to be completed within thirty days. The contractor was delayed by ice, and the time limit was, upon the request of the contractor, waived for this reason.

The work of the contractor was examined March 4, 9, 19, and 30, but the required depth over the wreck of 43 feet below mean low water had not been obtained. A further examination of the wreck is yet to be made.

- A total of \$1,371.40 had been expended on this work to June 30, 1907.

(k) *Wreck of canal boat Mamie Doherty in Hudson River, New York.*—This boat grounded on the channel bank of Hudson River, off the mouth of Poesten Kill, Troy, N. Y., November 20, 1906, and subsequently broke in two. It was reported to the Department April 20, 1907, and an allotment of \$1,100 for its removal was made April 24, 1907. The lowest bid received in response to written notice, dated April 9, 1907, was for \$950, which was accepted. Because of freshets the wreck had not been removed at the close of the fiscal year.

(l) *Wreck of lighter Hero in Newtown Creek, New York.*—The *Hero* sank in about 18 feet of water, mean low water, at the junction of Newtown Creek and English Kills, seriously obstructing navigation in that vicinity. It was reported to the Department on June 24, 1907, and an allotment of \$235 for its removal was made June 26, 1907.

Proposals for its removal were invited verbally, and the lowest bid received was for \$200. Award was made on June 24, 1907, and the wreck was reported removed on June 28, 1907, but an inspection to verify this report had not been completed at the close of the fiscal year.

(m) *Wreck of canal boat in entrance to Pogleys Creek, north of Classons Point, East River, New York.*—This wreck was reported June 10, 1907, by parties desiring to deliver a large quantity of material destined for a point in the creek above the obstruction.

Proposals for its removal were invited by written notice dated June 21, 1907, bids to be opened June 26, 1907, all wreckage to become the property of the successful bidder. Award was made to the lowest bidder, who proposed to do the work for \$594.

As it was important to remove the obstruction without unnecessary delay, an allotment of \$650 to pay the cost of removal and expenses incidental thereto was requested by telegraph June 26, 1907, and an allotment of this amount was made the same day.

Work on the wreck was commenced June 28, 1907, but had not been completed at the close of the fiscal year.

(See Appendix E 18.)

## EXAMINATIONS AND SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF MARCH 3, 1905.

Reports on preliminary examinations required by the river and harbor act approved March 3, 1905, of the following localities within this district were duly submitted by the district officer. They were reviewed by the Board of Engineers for River and Harbors, pursuant to law, and were transmitted to Congress and printed in documents as indicated.

1. *Preliminary examination of Long rock, Echo Bay, New York.*—Report dated June 27, 1906, is printed in House Document No. 182, Fifty-ninth Congress, second session. A plan for improvement at an estimated cost of \$18,000 is presented.

2. *Preliminary examination and survey of Hudson River, New York, with a view to extending the existing project from Troy to Waterford.*—Reports dated March 29 and December 28, 1906, respectively, are printed in House Document No. 539, Fifty-ninth Congress, second session. Alternative plans are presented for improvement estimated to cost \$934,900 and \$1,124,100.

## EXAMINATION AND SURVEY OF CONEY ISLAND CHANNEL AND ROCKAWAY INLET, NEW YORK, MADE IN COMPLIANCE WITH ACT OF CONGRESS APPROVED JUNE 28, 1906.

Report dated December 31, 1906, on preliminary examination and survey of Coney Island channel, New York, with a view to estimating the cost of securing a channel 20 feet deep and 600 feet wide at low tide, extending from deep water southwest of Nortons Point eastwardly to deep water off Rockaway Inlet and across the bar lying west of Rockaway Inlet to deep water in Jamaica Bay, was submitted by the district officer and was reviewed by the Board of Engineers for River and Harbors, pursuant to law. It was transmitted to Congress and printed in House Document No. 442, Fifty-ninth Congress, second session. Various plans for improvement are presented, but only that for Coney Island channel, at an estimated cost of \$168,300, and \$20,000 annually for maintenance, is deemed worthy of being undertaken by the United States.

## IMPROVEMENT OF NEW YORK HARBOR AND OF BAY RIDGE AND RED HOOK CHANNELS, NEW YORK; ENLARGEMENT OF GOVERNORS ISLAND, NEW YORK.

This district was in the charge of Lieut. Col. W. L. Marshall, Corps of Engineers. Division engineer, Col. Amos Stickney, Corps of Engineers, to June 4, 1907, and Col. D. W. Lockwood, Corps of Engineers, since June 4, 1907.

1. *New York Harbor, New York.*—Before the improvement of the main entrance into New York Harbor was undertaken by the United States the least depth in mid-channel on the outer bar was 23.7 feet at mean low water and about the same across three other shoals between the bar and deep water in the harbor. A large proportion of the commerce of the port, carried in vessels of greater draft, could cross these shoals only at or near high water.

The project for the improvement of Gedney channel was approved by the Secretary of War December, 1884, and extended to cover the

whole of the main entrance to the harbor December, 1886. It provided for dredging a channel 1,000 feet wide and 30 feet deep at mean low water from deep water below the Narrows, through Main Ship and Gedney channels, to deep water outside the bar. The estimated cost was \$1,490,000 for dredging 4,300,000 cubic yards. The actual amount dredged to October, 1891, when the work was approximately completed, was 4,875,079 cubic yards.

The existing project for maintenance of channels was approved November 15, 1892. The cost of this work varies in different years: it is estimated as averaging about \$50,000 annually.

Under these projects the amount expended up to June 30, 1907, is \$2,051,620.32, of which \$533,595.80 has been applied to maintenance of channels in the fifteen years since 1892, when the original project was completed.

As a result of these expenditures, channels to the sea have been obtained with a depth of 30 feet at mean low water and width of 1,000 feet or over, and have been maintained for the full depth with, as nearly as possible, the full width.

During the fiscal year ending June 30, 1907, the U. S. dredge *Gedney* excavated 93,643 cubic yards of mud and sand from Main Ship channel, deepening the mud shoals which form along the channel edges. In the Main Ship channel the tides run directly across the channel, which is over 5 miles long, and the resultant deposit of silt along the edges accumulates faster than the dredge *Gedney* can take it out. A full depth of 30 feet is maintained in the middle of this channel for width of 500 feet to 800 feet. Bayside and Gedney channels, which are farther seaward and more nearly true to the tide currents, retain practically their full depth and width.

The length of that part of New York Harbor included in the limits of the project for improvement (from Atlantic Ocean to the Battery, New York City) is  $22\frac{1}{2}$  miles by way of Sandy Hook, and (June 30, 1907) the channel has a depth of 30 feet or over throughout its entire length. For a length of about 8 miles this depth was made and is maintained under the project. The mean rise of tide is  $4\frac{1}{2}$  feet.

Future appropriations will be applied to the maintenance of these channels.

By the terms of the river and harbor act of 1899 a project was adopted for making an entrance to New York Harbor by way of Ambrose channel (formerly known as East channel), to be 2,000 feet wide and 40 feet deep at mean low water. It involves excavation of about 42,500,000 cubic yards of material for a length of 7 miles of channel. The work was authorized to be done under a continuing contract at a cost not exceeding \$4,000,000. Under act of March 3, 1903, two United States dredges were built to supplement the contract work, which was far behind the required rates. In October, 1906, the contractor abandoned the work, and the river and harbor act of 1907 authorized the building of two more United States dredges and changed the authorized limit for completion to \$5,148,510. The sum of \$1,635,000 is yet to be appropriated under the contract authorizations.

The original available depth through this channel was 16 feet at mean low water, the shoalest part being the outer bar. The channel was used only by towboats, scows, and other light-draft vessels.

To July 1, 1907, \$2,684,829.96 had been expended under this project in building two dredges and in excavating 26,308,914 cubic yards from the channel. The outer part of the channel for 11,000 feet length has been made 40 feet deep, with widths from 1,800 to 600 feet, and a cut of 35 feet depth has been made 400 to 1,000 feet wide through the rest of Ambrose channel. About 55 per cent of the project is completed.

Details of dredge construction will be found in Appendix H 9.

During the fiscal year ending June 30, 1907, 613,071 cubic yards of sand was removed under the continuing contract up to October 8, when the contractor's plant was withdrawn and the work abandoned. The contract was annulled December 3, 1906. The two Government dredges removed during the year 3,731,962 cubic yards of sand and mud, deepening to 35 feet the northeast half of the channel from the first bend to the inner end, a distance of about 15,000 feet, with widths of 400 to 800 feet.

The maximum draft which could be carried up this channel June 30, 1907, is 35 feet; the width in two places is yet too little for easy navigation and the channel has not been opened.

Future appropriations will be applied first to widening the 35-foot channel to a navigable width of about 1,000 feet, and subsequently to widening and deepening the channel to the projected dimensions.

By the river and harbor act of 1905 the removal of a rock in North River near pier 1 was authorized, and funds were provided by withdrawal of \$20,000 from the Ambrose channel appropriation, in addition to the \$25,000 similarly diverted by joint resolution of Congress approved July 1, 1902. A contract has been entered into for entire removal of the rock to 40 feet depth; about two-thirds of the area has been drilled and partly blasted, but no rock has yet been removed. Work has been much delayed by tows running into the contractor's plant.

The foreign exports and imports for the port of New York during the fiscal year ending June 30, 1906, amounted approximately to 11,782,000 tons, valued at \$1,460,812,356, being an increase over the valuation of 1886, before improvement was begun, of \$620,535,664. The entire cost of the improvement of New York Harbor up to date is less than 1 per cent of the increase in the value of foreign commerce alone for this port since the improvement began and less than one-third of 1 per cent of the present annual value of foreign commerce.

No statistics are kept of local and coastwise domestic commerce.

It is impossible to estimate the effect of the improvement upon freight rates. During 1906, 133 different ships drawing 27 feet or more made 666 trips outward and 132 trips inward. Prior to the improvement none of these ships could have crossed the bar and entered or left the harbor except at full high tide or after lightering.

The appropriation asked for Ambrose channel will be applied to the continuation of the project for a 40-foot channel, which has not yet been completed.

Further details of the harbor and improvements are printed in the Annual Report of the Chief of Engineers for 1897, page 1031.

A general description of the harbor, of the different channels, of the main entrance, and of the projects for improvement is printed in the Annual Report of the Chief of Engineers for 1901, pages 1285-

1287. A map of the harbor is printed in the Annual Report for 1903, page 914.

## GENERAL IMPROVEMENT.

July 1, 1906, balance unexpended-----	\$52, 207. 23
Amount appropriated by river and harbor act approved March 2, 1907--	125, 000. 00
	<hr/>
June 30, 1907, amount expended during fiscal year, for maintenance of improvement-----	177, 207. 23
	24, 303. 03
July 1, 1907, balance unexpended-----	152, 904. 20
July 1, 1907, outstanding liabilities-----	9, 939. 11
	<hr/>
July 1, 1907, balance available-----	142, 965. 09

## AMBROSE CHANNEL.

July 1, 1906, balance unexpended-----	\$640, 686. 50
Amount appropriated by sundry civil act approved March 4, 1907--	470, 000. 00
Received from sale of property and maps-----	20. 00
	<hr/>
June 30, 1907, amount expended during fiscal year:	1, 110, 706. 50
For works of improvement-----	<sup>a</sup> \$325, 041. 01
Transfer settlements, certificates Nos. 33843 and 44686-----	141. 50
	<hr/>
	325, 182. 51
July 1, 1907, balance unexpended-----	785, 523. 99
July 1, 1907, outstanding liabilities-----	30, 085. 03
	<hr/>
July 1, 1907, balance available-----	755, 438. 96
	<hr/>
Amount (estimated) required for completion of existing project--	1, 635, 000. 00
	<hr/>
{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907-----	<sup>c</sup> 765, 000. 00
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

## OBSTRUCTION IN NORTH RIVER.

July 1, 1906, balance unexpended-----	\$44, 181. 13
July 1, 1907, balance unexpended-----	44, 181. 13
July 1, 1907, amount covered by uncompleted contract-----	40, 000. 00

(See Appendix F 1.)

2. *Channel in Gowanus Bay—Bay Ridge and Red Hook channels, New York Harbor.*—These channels lie along the east shore of the upper bay, New York Harbor, and with Buttermilk channel form an easterly channel between the Narrows and East River, separated from the main channel by a broad shoal off Gowanus Bay and by Governors Island.

Bay Ridge and Red Hook channels had a natural low-water depth of 7 to 12 feet, and were available only for a limited harbor commerce.

<sup>a</sup> Includes \$929.11 expended by Maj. J. C. Sanford, Corps of Engineers, in connection with construction of dredges.

<sup>b</sup> Includes \$1,570.89 drawn by Maj. J. C. Sanford, Corps of Engineers, in connection with construction of dredges.

<sup>c</sup> Of this amount \$486,490 is under contract authorization of 1899 and \$278,510 under that of 1907.

The original project, adopted in 1881, provided for making these channels 18 feet deep and 200 feet wide, subsequently modified to make the depth 26 feet and width of 800 feet in Bay Ridge channel and 400 feet in Red Hook channel. This was completed in 1899 at a cost of about \$1,090,000.

The existing project was adopted by the river and harbor act of 1899, which provided for making Bay Ridge and Red Hook channels 40 feet deep at mean low water and 1,200 feet wide. The work was authorized to be done under a continuing contract at a cost not exceeding \$2,500,000, of which \$801,000 remains to be appropriated. Such a contract was entered into in 1899 for excavating about 22,000,000 cubic yards of material and completing the project. Work was begun in 1900 and prosecuted until November, 1906, generally at rates of progress less than required by the original contract. November 24, 1906, the last of the dredges was withdrawn from the work; the plant had been sold by the contractors and the new owners refused to continue dredging. The contractors failed to resume work when called upon, and the contract was annulled February 20, 1907.

Under this project, up to June 30, 1907, \$1,242,303.43 has been expended. About 80 per cent of the entire area to be dredged has been excavated to depths between 28 and 40 feet; 12,286,204 cubic yards has been removed, being about 55 per cent of the amount contracted for. In its present condition Bay Ridge channel is available for and is used by vessels of 30 feet draft up as far as Fortieth street; except for a few shoals, it has 35 feet depth up to that limit with about 800 feet width; above Fortieth street to Red Hook channel it has 30 feet depth and 700 feet width; toward Gowanus Creek the available depth is 26 feet. Red Hook channel has an available depth of 26 feet for about 800 feet width and 30 feet for about 300 feet width.

The total length of channel covered by the improvement is  $4\frac{1}{2}$  miles; the mean rise of tide is  $4\frac{1}{2}$  feet.

During the year ending June 30, 1907, up to November 24, 1,204,001 cubic yards was excavated and removed from the channels, widening Bay Ridge channel along its west edge near the lower end and on its east side toward Gowanus Creek, and further widening Red Hook channel.

The manner of doing the work was modified by the river and harbor act of 1907, permitting making a channel 35 feet deep prior to completing the projected 40-foot depth. Under this modification proposals have been invited for so much work as the available funds will pay for.

Future appropriations will be applied first to completing the channel of 35 feet depth, and thereafter to increasing the depth to 40 feet.

The commerce of this part of New York Harbor consists of coffee, cotton, sugar, coal, and miscellaneous freights, amounting in the calendar year 1905 to about 2,100,000 tons, valued at \$90,000,000.

Further details concerning these channels are contained in the Annual Report of the Chief of Engineers for 1899, page 1266.

House Document No. 337, Fifty-fourth Congress, second session, contains a report upon a survey of these channels, with map showing locations and depths as existing in 1897. (See Annual Report of the Chief of Engineers for 1897, p. 1177.)

July 1, 1906, balance unexpended.....	\$417, 679. 80
Amount appropriated by sundry civil act approved March 4, 1907--	200, 000. 00
Received from sale of condemned property and maps.....	23. 00
	<hr/> 617, 702. 80
June 30, 1907, amount expended during fiscal year, for works of improvement.....	160, 983. 23
	<hr/> July 1, 1907, balance unexpended..... 456, 719. 57
	<hr/>
Amount (estimated) required for completion of existing project..	<u>2, 051, 000. 00</u>
<hr/>	
{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907.....	
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

200, 000. 00

(See Appendix F 2.)

3. *Enlargement of Governors Island, New York Harbor.*—The project for this entire work, adopted under the terms of the sundry civil act of 1901, which made appropriations for beginning operations, included an addition of about 82 acres to the area of the island by inclosing with a bulkhead part of the shoal southwest of the island and filling the inclosure, the building of a wharf on the north shore and dredging to a depth of 26 feet in front of the wharf, and the erection of buildings. The work of enlargement, including construction of a wharf and dredging, all estimated to cost \$1,100,000, was assigned to the Engineer Department. By a modification of the project adopted in April, 1902, the enlargement was to be extended southwest over the shoal to reclaim an additional area of about 19 acres, making the total area of the enlargement about 101 acres.

Work was begun in August, 1901, and up to June 30, 1907, \$523,887.50 has been expended.

During the fiscal year 65,399 cubic yards of sand, etc., was delivered in the inclosure, of which 43,654 cubic yards was placed above mean low water in the embankment, when work of building up the bank was suspended by the contractors and has not been resumed; 1,982 linear feet of masonry sea wall has been built upon the riprap foundation; 6,019 tons of riprap has been added to strengthen the foundation.

The entire work done to June 30, 1907, consists in building a pile wharf, with a T head, 370 feet long, dredging the approaches 26 feet deep, laying intercepting sewers, building 6,795 linear feet of riprap bulkhead to inclose the area of enlargement, and upon the bulkhead building 6,775 linear feet of masonry sea wall, and in building an embankment to cover 37 acres above low water, 24 acres of which is above mean high water.

The sea wall is completed except a gap of 350 feet clear width, left to permit bringing in material for the embankment.

The available funds will be applied to continuing embankment construction.

Future appropriations will be applied to continuing and completing the project.



July 1, 1906, balance unexpended.....	\$400,761.50
Amount appropriated by sundry civil act approved March 4, 1907....	100,000.00
	<hr/> 500,761.50
June 30, 1907, amount expended during fiscal year, for works of improvement .....	74,649.00
July 1, 1907, balance unexpended.....	426,112.50
July 1, 1907, outstanding liabilities.....	94.00
	<hr/> 426,018.50
July 1, 1907, balance available.....	426,018.50
Amount (estimated) required for completion of existing project....	<hr/> 75,000.00
<hr/>	
{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907.....	
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897.	
	75,000.00

(See Appendix F 3.)

4. *Removing sunken vessels or craft obstructing or endangering navigation.*—*Schooner Hattie Douglass.*—This small and old fishing boat sank in the lower bay, New York Harbor, on or about March 12, 1907. She was removed and deposited on the beach, above high water, at Stapleton, Staten Island, at a cost of \$390.

(See Appendix F 4.)

#### IMPROVEMENT OF RIVERS AND HARBORS IN NORTHEASTERN NEW JERSEY.

This district was in the charge of Col. W. R. Livermore, Corps of Engineers, to October 26, 1906, and of Col. D. W. Lockwood, Corps of Engineers, since that date. Division engineer, Col. Amos Stickney, Corps of Engineers, to June 4, 1907.

1. *Passaic River, New Jersey.*—This river is a stream of considerable size, rising among the highlands in the northern part of New Jersey and flowing in a generally easterly and southerly course into Newark Bay. It is navigable from its mouth to Passaic, a distance of about 16 miles, where navigation is cut off by the Dundee Water Power and Land Company's dam. In its natural condition the navigable depth to Newark was about 7 feet at mean low water; from Newark to Passaic it was about 3 feet.

The first project for improvement, adopted by the river and harbor act of June 10, 1872, was for providing a channel from Newark to Passaic from 6 to 7½ feet deep and from 50 to 200 feet wide, the first cost being estimated at \$123,924. This was subsequently increased to \$193,822.

The second project was for improving the river below Newark and was authorized by the river and harbor act of June 14, 1880, at an estimated cost of \$353,875. It proposed a channel 200 feet wide and 10 feet deep at mean low water up to Center Street Bridge, Newark.

The two projects were consolidated by the river and harbor act of July 13, 1892, the estimated cost of the improvement being \$547,697.

The amount expended under this consolidated project up to the close of the fiscal year ending June 30, 1907, was \$483,297.14, of which \$389,610 was used in carrying out the projects and \$93,687.14 for maintenance. The sum of \$27.10 was received from the sale of blueprints.

Existing projects: That adopted by act of June 13, 1902, in accordance with the report submitted in House Document No. 401, Fifty-sixth Congress, first session, provides for making a channel from Staten Island Sound through Newark Bay and the said river to the Montclair and Greenwood Lake Railroad bridge 12 feet deep to the Nairn Linoleum Works, and 10 feet deep from that point to the said railroad bridge, a total distance of about 10.7 miles.

The estimated cost was originally \$296,000, but was subsequently increased, additional funds having been appropriated by the river and harbor act of March 3, 1905, and may now be stated at \$323,274.60. Work under this project was authorized to be done under continuing contracts, the total amount of the contract authorization being now appropriated. The yearly cost of maintenance is estimated at \$10,000. The amount expended on this project up to the close of the fiscal year ending June 30, 1907, was \$195,544.32.

The project of 1902 for the lower part of the river includes the old project below Newark, but leaves in force the part above Newark which is included between the Montclair and Greenwood Lake Railroad bridge and the city of Passaic. The work accomplished under this part of project consists of dredging a channel 6 feet deep at mean low water and with widths of from 90 to 100 feet through the shoals to the city of Passaic. Up to June 30, 1907, \$193,470.60, including maintenance, had been expended on this part of the project, of which \$150,734 was expended for the project and \$42,736.60 for maintenance work. The annual cost of maintenance is estimated at \$5,000.

By the passage of the river and harbor act approved March 2, 1907, a new project has been adopted, which provides for making a channel 16 feet deep at mean low water, 300 feet wide from deep water in Newark Bay to the Nairn Linoleum Works, 9.7 miles, thence 200 feet wide to the Montclair and Greenwood Lake Railroad bridge, 1.1 miles, in accordance with the report submitted in House Document No. 441, Fifty-ninth Congress, second session, estimated to cost \$1,216,775. The act provides for an expenditure of \$850,000 for prosecuting the work, of which \$650,000 is yet to be appropriated under continuing-contract authorization.

During the past fiscal year dredging has been carried on under three contracts for dredging contemplated under the project adopted by the act of Congress approved June 13, 1902. Channels of 12 feet in depth and from 100 to 200 feet in width have been completed from Newark Bay to a point about one-third mile above the New York and Lake Erie Railroad bridge, a total distance of about 9 miles. About four-fifths of the dredging contemplated by this project has been completed.

Dredging has also been in progress under contract for restoring the improvement between the Montclair and Greenwood Lake Railroad bridge and the city of Passaic. Ten thousand eight hundred and fourteen cubic yards of material and 21.19 cubic yards of bowlders were removed from Belleville and Rutherford Park bars.

Arrangements for beginning work under the project of March 2, 1907, have been in progress and the dredging was advertised on June 29, 1907.

The maximum drafts that could be carried June 30, 1907, were as follows: Twelve feet to a point one-half mile above the New York and

Lake Erie Railroad bridge, Newark, 6 feet to Rutherford, and 5 feet to Passaic. Mean range of tides: At mouth of river, 4.7 feet, and at Passaic, 2.5 feet.

It is proposed to apply the amount estimated as a profitable expenditure to continuation of the improvement in accordance with the adopted project.

The commerce of this river is mainly in building material, iron ore, fertilizers, coal, and general merchandise, and amounted to 2,037,363 tons in 1900, to 2,009,356 tons in 1901, to 2,494,312 tons in 1902, to 2,356,511 tons in 1903, to 2,567,942 tons in 1904, to 2,567,000 tons in 1905, and to 2,577,188 tons in 1906, valued at \$167,113,305, including the commerce of Hackensack River, which passes through Newark Bay.

This improvement is necessary to the great industrial interests and has reduced freight rates \$1 a ton on coal and building materials, and its continuance is necessary to the successful carrying on of the business of this locality.

Details as to this improvement may be found in the Annual Reports of the Chief of Engineers for 1896, pages 770-774, and for 1900, pages 177, 1530-1550.

Reports on examinations and surveys may be found under dates of January 23, 1837, and January 27, 1853, in the Annual Reports of the Chief of Engineers for 1872, page 807; 1884, page 780; and 1900, page 1530, and in House Document No. 441, Fifty-ninth Congress, second session.

Maps showing mouth of river and Newark Bay are printed in the Annual Reports of the Chief of Engineers for 1882, page 686, and 1887, page 766, and maps of the river in the vicinity of and above Newark are printed in House Document No. 401, Fifty-sixth Congress, first session, and of the full length of the bay and river under improvement in the Annual Report of the Chief of Engineers for 1905, page 1030.

July 1, 1906, balance unexpended.....	\$199,724.36
Amount appropriated by river and harbor act approved March 2, 1907.....	253,000.00
Received from sale of blueprints during the year.....	27.10
	<hr/>
	452,751.46
June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$49,308.64
For maintenance of improvement.....	4,907.18
	<hr/>
	54,215.82
July 1, 1907, balance unexpended.....	398,535.64
July 1, 1907, outstanding liabilities.....	20,154.25
	<hr/>
July 1, 1907, balance available.....	378,381.39
	<hr/>
July 1, 1907, amount covered by uncompleted contracts.....	75,889.91
Amount (estimated) required for completion of existing project...	1,016,775.00
	<hr/>
{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907.....	100,000.00
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

(See Appendix G 1.)

2. *Arthur Kill, or Staten Island Sound, and channel between Staten Island and New Jersey.*—(a) *Arthur Kill, or Staten Island Sound, New York and New Jersey.*—This is a waterway about 12 miles long, which, together with the lower end of Newark Bay, 2 miles long, and the Kill van Kull, 3 miles long, forms the inland waterway between upper New York Harbor and Raritan Bay. The section now contemplated under this improvement consists of the 14 miles of channel between Kill van Kull and Raritan Bay. The original depth through the Arthur Kill, or Staten Island Sound, at mean low water was 15 feet and upward, in a channel 100 to 1,000 feet in width. Through the lower end of Newark Bay the navigable channel depth is about 14 feet at mean low water, the result of an improvement commenced in 1874 and continued up to the present time. It is proposed in the present project to cut a new channel through the flats to the southward of the original channel, where the depth is about 1 foot at mean low water.

Projects: Sections of this waterway have been under improvement by the United States under the titles of "Channel between Staten Island and New Jersey," adopted in 1880, superseding the project of 1874, and "Arthur Kill," adopted in 1888. The former provided for a depth of 14 feet and width of 400 feet through the lower part of Newark Bay, and the latter for the removal of Steep Point, in order to straighten the channel to the southwestward of the Baltimore and Ohio Railroad bridge.

Details as to these projects are printed in the Annual Report of the Chief of Engineers for 1895, pages 969-972, and in current report under the head of "Channel between Staten Island and New Jersey," which project is still in force.

The existing project for this improvement, adopted by the river and harbor act approved June 13, 1902, provides for making and maintaining a channel from Kill van Kull to Raritan Bay, New York and New Jersey, by means of dredging and diking, 300 feet wide and 21 feet deep at mean low water, at an estimated cost of \$696,000, and \$5,000 for annual cost of maintenance. Work under this project is authorized to be done under continuing contracts, \$241,000 of the authorization still remaining to be appropriated. Reports upon examinations and surveys upon which the project is based are printed in the Annual Report of the Chief of Engineers for 1900, pages 1525-1530. The amount expended on the project to June 30, 1907, was \$230,713.47. The sum of \$6.60 was received from the sale of blue-prints.

Operations during the past fiscal year consisted in dredging, under a continuing contract approved by the Department on October 27, 1903, upon which work was commenced on December 2, 1903. During the year 274,653 cubic yards of material was removed from the channel between Corner Stake light and Elizabethport and at Storys flats between Port Reading and Sewaren. About one half of the work contemplated by this project has been completed, the work consisting of dredging north and west of Staten Island, from the easterly end of the channel to be improved, connecting with Kill van Kull for a length of about 3 miles, extending past Elizabethport to a point one-half mile below the Baltimore and Ohio Railroad bridge, with width of from 150 to 300 feet, and at the lower end of the im-

provement at Storys flats for a length of about 7,000 feet, with width of 300 feet. The dredging at Storys flats has opened up a length of 7 miles of the Arthur Kill—namely, from Perth Amboy to Carteret—to 21-foot navigation.

The maximum draft that could be carried through the waterway on June 30, 1907, was about 14 feet at mean low water. Mean range of tides, 5 feet.

It is proposed to apply the amount estimated as a profitable expenditure to dredging for the continuation of the improvement in accordance with the adopted project.

The freight carried through this waterway consists of oil, coal, ores, clay products, chemicals, fertilizers, grain, machinery, manufactures, and general merchandise, and amounted in 1899 to 11,311,991 tons, in 1900 to 11,047,633 tons, in 1901 to 11,651,300 tons, in 1902 to 14,517,079 tons, in 1903 to 11,512,420 tons, in 1905 to 11,721,861 tons, valued at \$265,193,813, and in 1906 to 16,574,840 tons, valued at \$355,579,817.

It appears from inquiry that no estimate can be made of the exact effect of the project on freight rates, except to the local commerce. The rates on this have been reduced by this improvement, and will be further reduced when the improvement has advanced to the extent of providing a practicable navigable channel of 21 feet.

Further reports on examinations and surveys are printed in House Document No. 591, Fifty-ninth Congress, first session, and House Document No. 337, Fifty-ninth Congress, second session.

Maps of this work are printed in House Document No. 393, Fifty-sixth Congress, first session, and in the Annual Report of the Chief of Engineers for 1905, page 1034.

July 1, 1906, balance unexpended.....	\$175, 217. 92
Amount appropriated by sundry civil act approved March 4, 1907....	85, 000. 00
Received from sale of blueprints during the year.....	6. 60

June 30, 1907, amount expended during fiscal year, for works of improvement .....	260, 224. 52
	<u>35, 931. 39</u>

July 1, 1907, balance unexpended.....	224, 293. 13
July 1, 1907, outstanding liabilities.....	36, 638. 01

July 1, 1907, balance available.....	<u>187, 655. 12</u>
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July 1, 1907, amount covered by uncompleted contracts.....	<u>282, 837. 49</u>
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Amount (estimated) required for completion of existing project....	<u>241, 000. 00</u>
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{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907.....	100, 000. 00	
		Submitted in compliance with requirements of sundry civil act of June 4, 1897.

(b) *Channel between Staten Island and New Jersey.*—This channel is an inland waterway, about 17 miles long, connecting New York Harbor with Raritan Bay. It consists of the Kill van Kull, connecting the upper bay with Newark Bay, and the Arthur Kill, connecting Newark Bay with Raritan Bay.

The natural depth through the channel was 15 feet or more, except for a distance of about  $1\frac{3}{4}$  miles in Newark Bay, where there was a shoal with a crooked channel  $9\frac{1}{2}$  feet deep, bordered by flats with depth of about 2 feet of water. The improvement of the "channel between Staten Island and New Jersey" consists in the deepening of the channel across this shoal.

The first project, adopted by the river and harbor act of June 23, 1874, was for making this channel from 14 to 16 feet deep, at an estimated cost of \$443,211. The only work done under it was the building of 2,237 linear feet of diking, at a cost of \$50,000.

The second and existing project was adopted in 1880, which, with subsequent modifications, proposed to dredge through the shoal a channel 400 feet wide and 14 feet deep at mean low water, the cost being estimated at \$210,000.

- A supplemental project was adopted by the river and harbor act of August 11, 1888, which had for its object the removal of the point of land known as "Steep Point," for the straightening of the channel to the westward of the Baltimore and Ohio Railroad bridge. This work was carried on under the title of "Improvement of Arthur Kill, New York and New Jersey," 1888-1895. The cost was estimated at \$26,500, and the work was completed in 1895, at a cost of \$25,401.30. This modification of the project brought the total cost of the improvement up to \$286,500.

The river and harbor acts of June 3, 1896, and June 13, 1902, extended the project to include the dredging of a channel in Lemon Creek, on Staten Island, at a cost of \$5,000 and \$5,000, respectively. This extension increased the total estimated cost of the improvement from the beginning to \$296,500. Annual maintenance is estimated at \$10,000.

The total amount expended to June 30, 1907, on the project, with its additions and modifications, was \$308,796.44, which was applied to diking, to dredging a channel 14 feet deep and 400 feet wide through the shoal in Newark Bay, to removing Steep Point, and to dredging a channel in Lemon Creek 8 feet deep at high water and from 35 to 50 feet wide; \$206,635.08 has been expended in carrying out the project and \$102,161.36 for maintenance. The work contemplated under this project has been completed.

During the past fiscal year, under appropriation for maintenance, act of March 3, 1905, 2,242 cubic yards of material was dredged under contract, and this work, together with that executed last year under same contract, sufficed to restore the channel to the full project dimensions throughout its entire length.

The maximum draft that could be carried June 30, 1907, through the channel between Staten Island and New Jersey was about 14 feet at mean low water and in Lemon Creek about 6 feet at mean high water to the head of navigation, a distance of about one-half mile from the mouth. Mean range of tides, 5 feet.

The freight carried through this channel consists of oil, coal, ores, clay products, chemicals, fertilizers, grain, machinery, manufactures, and general merchandise, and amounted in 1899 to 11,311,991 tons, in 1901 to 11,651,300 tons, in 1902 to 16,266,574 tons, in 1903 to 14,129,678 tons, and in 1905 to 14,339,120 tons, valued at \$325,625,465.

This is a connecting channel and no estimate can be made of the exact effect on the rates of freight, but it is known that the present commerce could not be carried on without this improvement, from which it is inferred that rates would be advanced if this improvement had not been made.

Reports on examinations and surveys are printed in Annual Reports of the Chief of Engineers for 1873, pages 943-947, and 1876, pages 251-257, and further details as to this improvement may be found in the Annual Reports of the Chief of Engineers for 1895, pages 969-970, and for 1896, page 775. Maps of this improvement are printed in the Annual Reports of the Chief of Engineers for 1881, page 696; 1889, pages 820-822; 1890, page 844; and 1905, page 1036, and in House Document No. 393, Fifty-sixth Congress, first session. Map of Lemon Creek is printed in the Annual Report of the Chief of Engineers for 1905, page 1036.

July 1, 1906, balance unexpended.....	\$11,384.92
June 30, 1907, amount expended during fiscal year, for maintenance of improvement .....	8,681.36
July 1, 1907, balance unexpended.....	2,703.56

## CONSOLIDATED.

July 1, 1906, balance unexpended.....	\$186,602.84
Amount appropriated by river and harbor act approved March 2, 1907..	85,000.00
Received from sale of blueprints during the year.....	6.60
	271,609.44

June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$35,931.39
For maintenance of improvement.....	8,681.36
	44,612.75

July 1, 1907, balance unexpended.....	226,996.69
July 1, 1907, outstanding liabilities.....	36,638.01

July 1, 1907, balance available.....	190,358.68
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July 1, 1907, amount covered by uncompleted contracts.....	282,837.49
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Amount (estimated) required for completion of existing project....	241,000.00
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Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907.....	100,000.00
Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

(See Appendix G 2.)

3. *Woodbridge Creek, New Jersey.*—This creek is a small, crooked tidal stream, about 5 miles long, running through flat marshes for most of its length and emptying into the west side of Arthur Kill, or Staten Island Sound, 2 miles north of Perth Amboy, N. J.

It is navigable for 2½ miles above the mouth to a point where it is crossed by a highway bridge without a draw. The width of the creek below this bridge is about 100 feet. In its original condition this stream was obstructed at its mouth by a bar having a least depth of 9.8 feet at high water, and by two shoals just inside the mouth. From these shoals a good 12-foot channel existed to above Anderson's

brick works, seven-eighths of a mile from the mouth, above which point, however, many shoals occurred, although a narrow 8-foot channel existed as far as Salamander dock,  $1\frac{1}{2}$  miles from the mouth.

First project: A survey of the navigable part of this creek was made in 1878, reference to which is made on page 139 of the Annual Report of the Chief Engineers for 1904, and a project for its improvement was adopted by the river and harbor act of March 3, 1879. This project provided for forming a channel 12 feet deep at mean high water and 80 feet wide from the mouth of the creek to the Salamander dock at an estimated cost of \$13,800, which amount was increased in 1884 to \$29,000. Work on this improvement was carried on under appropriations made from 1879 to 1882, amounting to \$19,000, which was expended without completing the project, and was suspended in 1883, and in 1900 the channel had relapsed to its original condition.

The existing project, adopted by the river and harbor act of June 13, 1902, contemplates obtaining a channel 8 feet deep at mean low water, with a bottom width of 50 feet, by dredging, from Arthur Kill to Salamander dock, at an estimated cost of \$35,000 for the improvement and \$3,000 annually for maintenance. A description of this project, and of the examination and survey upon which it is based, is contained in the Annual Report of the Chief of Engineers for 1900, page 1552.

The amount expended on the work of existing project up to the close of the fiscal year ending June 30, 1907, was \$23,306.60, of which \$15,322.70 was used in carrying out the project and \$7,983.90 for maintenance. About four-fifths of the work proposed under the project has been completed. During the past fiscal year 15,539 cubic yards of material was removed from the channel under a contract for continuing improvement and maintenance, and the projected dimensions obtained from the mouth to a point 700 feet above the New York and Long Branch Railroad bridge, a distance of 4,250 feet.

The maximum draft that could be carried June 30, 1907, over the shoalest part of the channel was 6 feet at mean low water. The mean range of tides is 5 feet.

The commerce of this creek, mainly in clay, brick, tile, coal, and building materials, amounted in 1887 to 126,000 tons, in 1898 to 176,000 tons, in 1903 to 155,751 tons, in 1904 to 165,313 tons, in 1905 to 160,194 tons, valued at \$1,018,198, and in 1906 to 167,392 tons, valued at \$1,128,237.

It appears from inquiry that freight rates have been reduced as a result of this improvement, and will be further reduced when the improvement is carried on throughout the entire length of the creek.

It is proposed to apply the available funds for the completion of the project.

Detailed description of this work may be found in the Annual Report of the Chief of Engineers for 1900, pages 1552-1555. Maps are printed in House Document No. 282, Fifty-sixth Congress, first session, and in Annual Report of the Chief of Engineers for 1905, page 1036.



July 1, 1906, balance unexpended-----	\$5, 766. 10
Amount appropriated by river and harbor act approved March 2, 1907-----	19, 000. 00
	<hr/>
June 30, 1907, amount expended during fiscal year, for works of improvement-----	24, 766. 10
	<hr/>
	5, 322. 70
July 1, 1907, balance unexpended-----	19, 443. 40
July 1, 1907, outstanding liabilities-----	16. 50
	<hr/>
July 1, 1907, balance available-----	19, 426. 90
(See Appendix G 3.)	

4. *Raritan Bay, New Jersey.*—This bay is a large body of water lying between the southern end of Staten Island and the New Jersey shore. Its greatest width north and south is about 5 miles and its greatest length east and west is about 7 miles. The Raritan River empties into it at its west end, between Perth Amboy and South Amboy, and the Arthur Kill, or Staten Island Sound, extends northward, connecting it with Newark Bay.

This bay had naturally a fairly straight channel, 11 feet deep, to South Amboy. The line of the deepest water, however, followed the Staten Island shore from Perth Amboy to Seguine Point, where it was separated from deep water in the eastern part of the bay by a shoal 1.5 miles broad, with a minimum depth of 14.5 feet.

The original and existing project, adopted March 3, 1881, and extended September 19, 1890, and June 3, 1896, provides for dredging channels 300 feet wide and 21 feet deep from Seguine Point to deep water in the bay, a distance of about 1.5 miles, through two shoals opposite Wards Point, 0.4 and 0.6 mile long, respectively, and from South Amboy to deep water near Great Beds light, a distance of about 1.5 miles. The estimated cost of the work is \$507,875.

Reference to reports on examinations and surveys are noted in the Annual Report of the Chief of Engineers for 1904, pages 140 and 1158.

The amount expended on the work up to the close of the fiscal year ending June 30, 1907, was \$530,005.82, of which \$297,314.45 was used in carrying out the project and \$232,691.37 for maintenance. The project has been completed, and the only work now contemplated is maintenance of the improvement.

During the past fiscal year, under a contract in progress and partly completed last year, 101,561 cubic yards of material was removed from the South Amboy, Seguine Point, and Wards Point channels, and these channels were practically restored to their projected dimensions.

The maximum draft that could be carried June 30, 1907, through the Wards Point, South Amboy, and Seguine Point channels was 21 feet at mean low water. Mean range of tides, 5 feet.

The commerce of the bay is mainly in coal, brick, manufactures, and general merchandise, and amounted in 1901 to 4,722,048 tons, in 1902 to 5,453,122 tons, in 1903 to 4,484,152 tons, in 1905 to 5,296,986 tons, and in 1906 to 6,432,245 tons, valued at \$114,358,610.

It appears from statements of the shipping interests of the great railroad terminals that the improvements have resulted in a great reduction of towing rates and a proportionate reduction of freight

rates, owing to the greater quantity of coal that can be carried and towed through these channels over that which was carried before the improvement was made. It is stated that the further improvement of the channels in question will work beneficially to the consumers and carriers in the same direction or proportion as heretofore.

Further details of this improvement are printed in the Annual Report of the Chief of Engineers for 1896, pages 787-789. Maps are printed in the Annual Report of the Chief of Engineers for 1905, page 1038.

July 1, 1906, balance unexpended.....	\$34, 134. 12
Amount appropriated by river and harbor act approved March 2, 1907.....	25, 000. 00
September 29, 1907, refundment of overpayment.....	20
	<hr/>
	59, 134. 32
June 30, 1907, amount expended during fiscal year, for maintenance • of improvement.....	<hr/>
	26, 639. 94
July 1, 1907, balance unexpended.....	<hr/>
July 1, 1907, outstanding liabilities.....	32, 494. 38
	<hr/>
	4, 645. 98
July 1, 1907, balance available.....	<hr/>
	27, 848. 40

(See Appendix G 4.)

5. *Keyport Harbor, Matawan Creek, Raritan, South, and Elizabeth rivers, Shoal Harbor and Compton Creek, and Cheesapeake Creek, New Jersey.*—(a). *Keyport Harbor.*—This harbor is situated at the mouth of Matawan Creek, on the south side of Raritan Bay, 5 miles east of the mouth of Raritan River, and it consists of a bay about 1 mile broad.

There was no distinct natural channel in the harbor, the available depth to the wharves being less than 4 feet at mean low water. A 6-foot channel had been dredged at private expense before the United States assumed charge of the improvement, but it had shoaled again to 3 feet.

The original and existing project, approved August 2, 1882, with subsequent modifications (1884) contemplates dredging an 8-foot channel 4,700 feet long and 200 feet wide from Raritan Bay to the steamboat dock at Keyport, at an estimated cost of \$40,475. Reference to report on examination and survey is noted in the Annual Report of the Chief of Engineers for 1905, page 148.

The amount expended to June 30, 1907, was \$59,248.77, of which sum \$30,500 was used in carrying out the project and \$28,748.77 in maintenance. A channel of the required length and nearly the proposed width was completed in 1883-84. Deterioration to the amount of about 60 per cent now exists.

No work was done on the improvement during the fiscal year. An allotment of \$8,705.97 from the consolidated appropriation, act of March 2, 1907, was made, and a contract for dredging has been entered into. The available funds will probably be sufficient to restore the dredged channel.

The maximum draft that could be carried June 30, 1907, to the Keyport wharves was about 7 feet at mean low water. Mean range of tides, 4.9 feet.

The commerce of this harbor is mainly in farm products, fertilizers, coal, lumber, fish, shellfish, and miscellaneous freight, and amounted

to 67,500 tons in 1899, to 45,000 tons in 1901, to 62,000 tons in 1903, to 70,000 tons in 1904, to 86,821 tons in 1905, valued at \$2,202,105, and in 1906 to 229,377 tons, valued at \$3,074,060, including the commerce of Matawan Creek.

The effect of this improvement has been to greatly reduce freight rates, especially in the marketing season.

It is proposed to apply the available balance toward the maintenance of the improvement in accordance with the adopted project.

Further details as to this work are printed in the Annual Report of the Chief of Engineers for 1897, page 1147. Map is printed in the Annual Report of the Chief of Engineers for 1905, page 1040.

July 1, 1906, balance unexpended.....	\$2, 659. 52
Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	8, 705. 97
	<hr/> 11, 365. 49
June 30, 1907, amount expended during fiscal year, for maintenance of improvement .....	1, 433. 29
	<hr/> 9, 932. 20
July 1, 1907, balance unexpended.....	9, 932. 20
July 1, 1907, outstanding liabilities .....	45. 00
	<hr/> 9, 887. 20
July 1, 1907, balance available.....	<hr/> 9, 887. 20
July 1, 1907, amount covered by uncompleted contracts.....	8, 000. 00
Amount (estimated) required for completion of existing project.....	9, 975. 00

(b) *Matawan Creek*.—This creek is a small tidal stream in the eastern part of New Jersey, which discharges into Raritan Bay at Keyport Harbor. It is navigable up to the bridge of the New York and Long Branch Railroad, about 2 miles above its mouth.

In its natural condition the mouth was obstructed by a mud flat, through which a narrow and crooked 3-foot channel existed. Above this flat there was a 4-foot channel for a mile and beyond a narrow 3-foot channel extending nearly up to the head of navigation at Matawan.

The original and existing project for improving this stream, by dredging a 4-foot channel 100 feet wide from the mouth to Winkson Creek, about 1 mile, and thence 75 feet wide to the railroad bridge at Matawan, was adopted March 3, 1881. The cost was estimated at \$33,120. Reference to report on examination and survey is noted in the Annual Report of the Chief of Engineers for 1905, page 149.

The amount expended to June 30, 1907, was \$50,808.79, of which \$21,000 was used in carrying out the project and \$29,808.79 for maintenance. About two-thirds of the work proposed under the project has been completed, and a channel has been dredged the required distance with widths of 50 to 100 feet.

An allotment of \$6,000 was made from consolidated appropriation, act of March 2, 1907, and will be applied to maintenance. A contract has been entered into, but work had not been commenced at the close of the fiscal year.

The maximum draft that could be carried June 30, 1907, was 3½ feet at mean low water. Mean range of tides, 4.9 feet.

The commerce of this creek is in brick, fertilizer, farm produce, and general merchandise, and amounted to 51,000 tons in 1899, to 60,000 tons in 1901, to 61,500 tons in 1903, to 29,600 tons in 1904, to 58,471

tons in 1905, valued at \$203,955, and in 1906 to 128,181 tons, valued at \$717,505.

The effect of this improvement has been to greatly reduce rates of freight, especially in the marketing season.

Further details as to this improvement may be found in the Annual Report of the Chief of Engineers for 1897, page 1145. Map is printed in the Annual Report of the Chief of Engineers for 1905, page 1042.

Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	\$6,000.00
June 30, 1907, amount expended during fiscal year, for maintenance of improvement .....	4.40
July 1, 1907, balance unexpended .....	5,995.60
July 1, 1907, amount covered by uncompleted contracts.....	5,000.00
Amount (estimated) required for completion of existing project.....	12,120.00

(c) *Raritan River*.—This river is a moderate-sized stream flowing through the central part of the State of New Jersey and emptying into Raritan Bay at Perth Amboy. It is navigable to New Brunswick, N. J., a distance of 12 miles, where it is the eastern terminus of the Delaware and Raritan Canal.

In its natural state the channel to New Brunswick was obstructed by several extensive shoals, on which the depth was from  $6\frac{1}{2}$  to  $8\frac{1}{2}$  feet at mean low water.

The original and existing project for improvement, adopted June 18, 1878, with subsequent modifications, provided for a channel 200 feet wide and 10 feet deep from the mouth to the Delaware and Raritan Canal terminus at New Brunswick, including a south channel between Crab Island and Kearney's dock, with a length of about  $2\frac{1}{2}$  miles, width of 100 feet, and depth of  $5\frac{1}{2}$  feet at mean low water, to be obtained by dredging, diking, and rock excavation, the cost being estimated at that time at \$2,093,662. Recent and improved methods for doing such work have made it probable that this estimate will not exceed \$1,035,000.

The amount expended up to the close of the fiscal year ending June 30, 1907, was \$710,393.76, of which \$659,192.32 was used in carrying on the work and \$27,669.18 for maintaining that already done. The sum of \$1.15 has been received from sale of condemned property. About two-thirds of the work contemplated under the project has been completed.

The following has been accomplished under the project: A channel 10 feet deep has been made from the mouth to the Delaware and Raritan Canal terminus at New Brunswick, the section through and below the reef at Whitehead's dock having a width of 200 feet and the section above the reef a width of 100 feet. South channel has been dredged to the projected depth and width for a length of 4,000 feet.

Dredging in progress at the close of the last fiscal year was continued until July 27, upon which date the contract was completed. Fifteen thousand and forty-nine cubic yards of material was dredged in removing shoals at Mrs. Ellis' Grave and Bishops Point and in restoring South channel for a length of 1,200, width of 60, and depth of 6 to 7 feet.

An allotment of \$16,975.42 from consolidated appropriation, act of March 2, 1907, was made for this improvement and will be applied to maintenance. A contract for work under this allotment has been entered into.

On June 30, 1907, the maximum draft that could be carried to the head of navigation was 9 feet at mean low water. Mean range of tides: At mouth of river, 5.1 feet; at New Brunswick, 5.56 feet.

The commerce of this river is principally in coal, ores, lumber, building materials, and general merchandise, and amounted in 1901 to 1,266,950 tons, in 1902 to 1,228,791 tons, in 1903 to 1,020,420 tons, in 1905 to 605,197 tons, and in 1906 to 736,666 tons, valued at \$17,377,645.

It appears from numerous letters received that this improvement has most certainly resulted in a very material reduction of freight rates.

Details as to this improvement may be found in the Annual Reports of the Chief of Engineers for 1892, page 881; for 1896, page 780; for 1897, page 1136, and further information is contained in the report for 1900, page 1505.

Maps of the river are printed in report upon surveys, under date of June 20, 1832, and Annual Reports of the Chief of Engineers for 1874, Part 2, page 173; for 1885, page 760, and for 1905, page 1044.

July 1, 1906, balance unexpended.....	\$14,623.52
Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	16,975.42
	<hr/>
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	31,598.94
	<hr/>
July 1, 1907, balance unexpended.....	11,766.13
July 1, 1907, outstanding liabilities.....	<hr/>
	19,832.81
	337.96
	<hr/>
July 1, 1907, balance available.....	19,494.85
	<hr/>
July 1, 1907, amount covered by uncompleted contracts.....	16,000.00
Amount (estimated) required for completion of existing project.....	373,392.68

(d) *South River*.—This is a small stream in the central part of New Jersey, which discharges into the Raritan River about 8 miles above its mouth. Before improvement by the United States a private canal about three-fourths of a mile long had been dredged from near Washington, on the South River, to Sayreville, on the Raritan River, which shortened the sailing course about 2 miles.

The depth in the canal was about 3.5 feet and in the river about 2.5 feet as far as Oldbridge, at the head of navigation, 6.3 miles above the canal.

The first project for this improvement was adopted March 3, 1871, and provided for dredging a channel 6 feet deep at mean low water up to the Washington wharves, at an estimated cost of \$13,653. This was completed in 1874, at a cost of \$20,000.

Report upon survey is printed in Annual Report of the Chief of Engineers for 1871, page 698.

The existing project, adopted June 14, 1880, provides for correcting the canal outlet and for obtaining, by dredging and diking, a channel 100 feet wide and 8 feet deep to Washington, 1.5 miles above the mouth; thence 6 feet deep to Bissetts, 3.7 miles above the mouth;

thence 4 feet deep to Oldbridge, 6.3 miles above the mouth, at the head of navigation. The cost was estimated at \$194,695, but was reduced in 1892 to \$176,695. Reference to examination and survey is contained in the Annual Report of the Chief of Engineers for 1905, page 150.

The amount expended on the present project up to the close of the fiscal year ending June 30, 1907, was \$98,423.67, of which \$78,000 was used in carrying on the work and \$20,423.67 for maintenance. About three-eighths of the work contemplated under the project has been completed. Below the wharves at the village of South River a channel from 50 to 75 feet wide and 8 feet deep has been dredged and the projected dikes have been built. Above the village a channel from 50 to 75 feet wide and 6 feet deep has been dredged as far as the Raritan River Railroad bridge.

An allotment of \$13,178.63 from consolidated appropriation, act of March 2, 1907, was made for this work and a contract has been entered into for the proposed work.

The maximum draft that could be carried to South River on June 30, 1907, was about 7 feet, to the highway bridge  $6\frac{1}{2}$  feet, and to the railroad bridge above about  $4\frac{1}{2}$  feet at mean low water. Mean range of tides: At canal, 5.34 feet; at Oldbridge, 4.57 feet.

Large brickyards established along the banks of the river give it a commercial importance out of proportion to its size.

The commerce is principally in brick, sand, clay, coal, fertilizer, and general merchandise, and amounted in 1899 to 343,202 tons, in 1901 to 328,186 tons, in 1902 to 387,246 tons, in 1903 to 333,890 tons, in 1904 to 392,626 tons, in 1905 to 260,204 tons, valued at \$1,046,208, and in 1906 to 226,227 tons, valued at \$972,550.

The improvement has caused a great reduction in freight rates, and it appears probable that the rates will be further reduced when the improvement reaches the upper stretches of the river. From reliable information received it appears that as a result of this improvement a reduction in freight rates on fire brick by rail to Boston of from \$3.25 to \$2 per ton has been made. The freight rate by rail to New York is \$1.60 per ton; by water it is 75 cents per ton.

Details as to this improvement may be found in the Annual Report of the Chief of Engineers for 1896, pages 784-785.

It is proposed to apply the available balance to continuing and maintaining the improvement in accordance with the adopted project.

Sketches of South River are printed in the Annual Reports of the Chief of Engineers for 1882, page 678; 1885, page 764, and 1905, page 1046.

July 1, 1906, balance unexpended.....	\$4,867.12
Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	13,178.63
	<hr/> 18,045.75
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	290.79
July 1, 1907, balance unexpended.....	17,754.96
July 1, 1907, outstanding liabilities.....	57.08
July 1, 1907, balance available.....	<hr/> 17,697.88
July 1, 1907, amount covered by uncompleted contracts.....	14,000.00
Amount (estimated) required for completion of existing project.....	88,695.00

(e) *Elizabeth River*.—This is a small stream in the eastern part of New Jersey which discharges into the Arthur Kill at Elizabethport. Before improvement by the United States its width varied from 50 to 90 feet, and it had a high-water depth of 4 feet at the head of navigation at Broad street, Elizabeth, about  $2\frac{3}{4}$  miles above its mouth.

The original and existing project, approved March 3, 1879, consists in dredging a channel 60 feet wide and 7 feet deep at mean high water, at an estimated cost, revised in 1881, of \$43,160. Reference to examination and survey is noted in the Annual Report of the Chief of Engineers for 1905, page 151.

The amount expended on this work to June 30, 1907, was \$49,951.25, of which \$27,000 was used for carrying out the project and \$22,951.25 for maintenance. About two-thirds of the work contemplated under this project has been completed. A channel 7 feet deep at mean high water and from 30 to 60 feet wide has been dredged from the mouth to Bridge street, Elizabeth.

An allotment of \$9,784.45 from consolidated appropriation, act of March 2, 1907, was made for this improvement and will be applied to maintenance, but work had not been commenced at the close of the fiscal year.

The maximum draft that could be carried to Bridge street, Elizabeth, about one-fourth mile from the head of navigation at Broad street, on June 30, 1907, was about 4 feet at mean high water. Mean range of tides: At mouth, 4.7 feet; at Bridge street, Elizabeth, 3.4 feet.

The commerce of the river is in coal, building materials, and miscellaneous freights. It amounted to 21,650 tons in 1895, to 28,865 tons in 1897, to 29,495 tons in 1901, to 40,250 tons in 1902, to 37,136 tons in 1903, to 36,336 tons in 1904, to 28,887 tons in 1905, valued at \$247,717, and in 1906 to 43,255 tons, valued at \$352,784.

It appears from statements received from shippers that there has been a reduction in freight rates, probably due to this improvement.

Reports of preliminary examination and survey are printed in Annual Reports of the Chief of Engineers for 1895, page 1011, and 1897, page 1185.

Details in reference to this improvement may be found in the Annual Reports of the Chief of Engineers for 1896, page 778, and 1897, pages 1134 and 1185. Map is printed in the Annual Report of the Chief of Engineers for 1905, page 1048.

July 1, 1906, balance unexpended.....	\$221. 87
Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	9, 784. 45
	<hr/> 10, 006. 32
June 30, 1907, amount expended during fiscal year, for maintenance of improvement .....	13. 12
	<hr/> 9, 993. 20
July 1, 1907, balance unexpended.....	8, 000. 00
Amount (estimated) required for completion of existing project....	16, 160. 00

(f) *Shoal Harbor and Compton Creek*.—This harbor is on the south shore of Raritan Bay, 5 miles from Sandy Hook. Compton Creek is a narrow stream emptying into it. The natural harbor is inside the mouth of the creek, where the depth is from 3 to 6 feet at

mean low tide. The creek is navigable for about 1 mile above its mouth, where it is crossed by a railroad bridge without a draw. One-fourth of a mile above its mouth it is crossed by a highway drawbridge.

The entrance to this harbor was originally obstructed by a broad flat shoal on which there was a depth of less than 1 foot at mean low tide, the distance between the deep water in the creek and the 4-foot depth in the bay being about one-half mile.

The original and existing project, adopted September 19, 1890, proposes a channel 4 feet deep connecting Compton Creek with Raritan Bay, the width to be 150 feet in the bay and 75 feet in and near the mouth of the creek, the channel through Shoal Harbor to be protected by a dike if necessary, at an estimated cost of \$64,130.

Report of examination and survey upon which this project was based is printed in Annual Report of the Chief of Engineers for 1884, Part 1, page 770.

The amount expended to June 30, 1907, was \$36,757.37, of which sum \$17,000 was applied to carrying out the project and \$19,757.37 for maintenance. About three-fifths of the dredging contemplated under this project has been completed and a 4-foot channel 75 feet wide has been dredged through Shoal Harbor, connecting Raritan Bay with Compton Creek.

Nothing in furtherance of the project was done during the past fiscal year.

An allotment of \$9,750.57 from consolidated appropriation, act of March 2, 1907, was made for this improvement and will be applied to maintenance. Work under this allotment had not been commenced at the close of the fiscal year.

The maximum draft that could be carried June 30, 1906, in the improved channel through Shoal Harbor and Compton Creek to the drawbridge was 3½ feet at mean low water. Mean range of tides, 4.5 feet.

The commerce of this locality in farm and fish products, fertilizers, and general merchandise amounted to 180,000 tons in 1901, to 48,790 tons in 1902, to 65,175 tons in 1903, to 28,570 tons in 1904, to 34,340 tons in 1905, valued at \$1,198,200, and in 1906 to 34,538 tons, valued at \$1,167,920.

It appears from statements received from shippers that there has been a reduction on coal freights of 40 per cent, on manure from 40 to 50 per cent, and on fish 20 per cent, as a result of this improvement, and if the improvement is not continued the rates would be very much advanced.

Further details as to this improvement may be found in the Annual Report of the Chief of Engineers for 1897, page 1150. Map is printed in the Annual Report of the Chief of Engineers for 1905, page 1050.

July 1, 1906, balance unexpended.....	\$657. 02
Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	9, 750. 57
	<hr/> 10, 407. 59
June 30, 1907, amount expended during fiscal year, for maintenance of improvement .....	414. 39
	<hr/> 9, 993. 20
July 1, 1907, balance unexpended.....	8, 000. 00
Amount (estimated) required for completion of existing project.....	47, 130. 00



(g) *Cheesequake Creek*.—This is a small stream in the eastern part of New Jersey which discharges into Raritan Bay, about 2 miles east of South Amboy. Before improvement by the United States the available navigable depth in the creek was  $1\frac{1}{2}$  feet at mean low water over the shoals, the distance from the entrance to the upper limit of navigation being  $3\frac{1}{2}$  miles.

The existing project was adopted June 14, 1880, and provided for a new outlet, 5 feet deep, from the creek into Raritan Bay, at right angles to the shore line through a beach which put across the mouth of the creek from the right bank, and which had forced the outlet nearly one-half mile to the westward. This was to be obtained by dredging and constructing parallel jetties of stone, 200 feet apart, on each side of the dredged channel; the old outlet was to be closed by a pile dike, and a channel, 4 feet deep and from 50 to 100 feet wide, was to be dredged from the mouth to the head of navigation,  $3\frac{1}{2}$  miles up the creek. In this distance two dikes were to be built, and a new channel to be made through the marsh was to cut off a bend in the creek. Stump Creek, a tributary stream emptying into the creek near its mouth, was to be improved by dredging a channel 50 feet wide and 3 feet deep.

The cost was estimated at \$75,279, which was revised in 1885 to \$90,000.

Reference to survey is noted in the Annual Report of the Chief of Engineers for 1905, page 152.

The amount expended on the present project up to the close of the fiscal year ending June 30, 1907, was \$45,356.18, of which \$40,000 was used in carrying out the project and \$5,356.18 in maintenance. About four-ninths of the work contemplated under this project has been completed, and the work accomplished consists of the construction of the two parallel stone jetties at the mouth, the dredging of a 5-foot channel between them connecting the creek with the 5-foot curve in Raritan Bay, and the construction of the pile dike closing the old outlet.

During the past fiscal year 1,868 cubic yards of material was dredged in restoring the channel for widths of 50 to 90 feet from the end of the jetties, a distance of about 800 feet, to the 5-foot curve in Raritan Bay.

An allotment of \$3,604.96, from consolidated appropriation, act of March 2, 1907, was made for the restoration of the channel. No work had been done under this allotment at the close of the fiscal year.

The maximum draft that could be carried through the mouth of the creek on June 30, 1907, was about 4 feet. Mean range of tides, 5.1 feet.

The commerce of the creek is principally in fertilizer, sand, clay, and farm produce, and amounted in 1886 to about 50,000 tons; in 1905 to 45,500 tons, valued at \$146,050, and in 1906 to 83,648 tons, valued at \$625,000.

Further details as to this improvement may be found in the Annual Report of the Chief of Engineers for 1886, page 763.

Sketches of Cheesequake Creek are printed in the Annual Reports of the Chief of Engineers for 1882, page 680, and in 1905, page 1051.

July 1, 1906, balance unexpended-----	\$3,569.03
Amount allotted from appropriation by river and harbor act approved March 2, 1907-----	3,604.96
	<hr/> 7,173.99
December 27, 1906, returned to Treasury-----	\$252.68
June 30, 1907, amount expended during fiscal year, for maintenance of improvement-----	2,925.21
	<hr/> 3,177.89
July 1, 1907, balance unexpended-----	3,996.10
July 1, 1907, outstanding liabilities-----	2.00
	<hr/> 3,994.10
July 1, 1907, balance available-----	<hr/> 3,994.10
July 1, 1907, amount covered by uncompleted contracts-----	3,400.00
Amount (estimated) required for completion of existing project----	50,000.00

## CONSOLIDATED.

July 1, 1906, balance unexpended-----	\$26,598.08
Amount appropriated by river and harbor act approved March 2, 1907-----	68,000.00
	<hr/> 94,598.08
December 27, 1906, returned to Treasury-----	\$252.68
June 30, 1907, amount expended during fiscal year, for maintenance of improvement-----	16,847.33
	<hr/> 17,100.01
July 1, 1907, balance unexpended-----	77,498.07
July 1, 1907, outstanding liabilities-----	442.04
	<hr/> 77,056.03
July 1, 1907, balance available-----	<hr/> 77,056.03
July 1, 1907, amount covered by uncompleted contracts-----	62,400.00
Amount (estimated) required for completion of existing project----	607,472.68

(See Appendix G 5.)

6. *Shrewsbury River, New Jersey.*—This river is a large tidal basin in the eastern part of New Jersey, and consists of two bays, each having an area of about 3 square miles, and known, respectively, as the North Branch (or Navesink River) and the South Branch, and a channel called the main stem, which unites the two branches at their eastern ends and extends northwardly to the outlet at southeast end of Sandy Hook Bay. The river is navigable on the North Branch to Red Bank, 8 miles from the mouth, where it is crossed by three bridges without draws, and on the South Branch to Branchport, 9 miles from the mouth; also to Little Silver, Oceanport, Parkers Creek, North Long Branch, and Monmouth Beach, on the several arms of the South Branch.

The part of the river which has been under improvement by the United States consists of the main stem, the North Branch to Oceanic, 5 miles from the mouth, and the South Branch to the vicinity of Seabright, about 5½ miles from the mouth. The bays above Oceanic and Seabright had sufficient water to accommodate navigation.

Before any improvement was begun by the United States the available depth to Oceanic, on the North Branch, was 3½ feet, and to Seabright, on the South Branch, it was 2½ feet; the depth in the main stem was 4 feet. For details see Annual Report of the Chief of Engineers for 1886, page 756.

By act of Congress of August 30, 1852, \$1,500 was appropriated for and expended upon a survey to ascertain the extent of a break through the beach between the Shrewsbury River and the ocean, but no work of improvement was begun.

First project: By act of Congress of July 11, 1870, a survey of the river was ordered. The report on this survey described a bar across the river nearly opposite the Navesink lights and four smaller bars above, and recommended deepening them by dredging, at an estimated cost of \$14,000. The work was completed under appropriations amounting to \$19,000, made in 1871 and 1873, and a new shoal near Lower Rocky Point was also dredged. The dredged channels did not long maintain the improved depth (6 feet at low tide).

Existing project, with modifications: The river and harbor act of 1875 provided for a survey of the "North and South branches of the Shrewsbury River, New Jersey." The project provided for dredging at Upper and Lower Rocky Point and a training dike at the entrance to the North Branch, at a total estimated cost of \$18,000. This sum was appropriated by the river and harbor act of 1878, but before beginning the work it was decided to make a new and more detailed survey of the river. This survey was made in 1878, and the report presented a plan for improving both branches of the river and main stem to obtain a channel of 6 feet depth at mean low water, with a width of 300 feet in the main stem and of 150 feet in each of the branches, by dredging and constructing pile dikes or training walls. At this time the available depth in the main stem was found to be 5.4 feet at mean low water, in the North Branch 3.5 feet, and in the South Branch, at the entrance, 2.6 feet, practically suspending all navigation in the latter channel. The plan was referred to a Board of Engineers, and with slight modifications was approved by it February 12, 1879. It provided for the construction of seven pile dikes and for dredging at seven different shoal points, at a total estimated cost of \$142,086. This project was adopted March 3, 1879, when an appropriation of \$10,000 was made for beginning work. No essential modification of this project has since been made. Nine dikes have been built and the shoals have been dredged and redredged frequently in order to maintain the proposed depth of 6 feet. Owing to the change in diking and to the cost of dredging being generally greater than originally estimated, it was found necessary in 1881, 1883, and 1887 to add to the estimate for the completion of the whole work. The existing project for improvement, therefore, is the project of 1879, with the modifications indicated above, and proposes to secure a channel of 6 feet depth at mean low water, with width of 300 feet up to the junction of the North and South branches and with a width of 150 feet in those branches, by means of dredging and diking, at an estimated cost (including appropriation of 1878 applied to this project) of \$234,062.

The sum expended under the existing project to the close of the fiscal year ending June 30, 1907, was \$336,018.55, of which \$195,393.95 was for carrying out the project, \$135,624.60 for maintenance, and \$5,000 for the survey made in 1903. The project is completed, dredging and dike repairs being required for maintenance of channels.

During the past fiscal year dredging was in progress under two contracts, both under appropriation of March 3, 1905, "for continuing

improvement and for maintenance." Under the first, which was in force at the close of the last fiscal year, 17,112 cubic yards of material was removed from Island Beach bar. Under the second, 1,840 cubic yards was removed from Island Beach bar, 3,455 cubic yards from Upper Crossover, and 3,216 cubic yards from Reeves channel. This contract is still in force.

The maximum draft that could be carried June 30, 1907, throughout the limits of the improvement was 5 feet at mean low water in channels not less than 50 feet in width. Mean range of tides: Outer bar, 5 feet; Highlands bridge, 3 feet; Seabright bridge, 1.3 feet.

The commerce of this river, mainly in coal, farm products, fertilizer, and general merchandise, amounted in 1889 to 906,000 tons; in 1902 to 657,000 tons; in 1903 to 761,000 tons; in 1904 to 780,290 tons; in 1905 to 1,768,500 tons, valued at \$8,215,000, and in 1906 to 1,668,500 tons, valued at \$7,235,000. The passenger traffic is important, the number of people carried by the Patten Line, South Branch, in 1902 being 264,635; in 1903, 277,257; in 1904, 266,157, and in 1905, 310,367.

It is proposed to apply the available balance to maintenance of the improvement in accordance with the project.

Further details in reference to this work may be found in the Annual Reports of the Chief of Engineers for 1896, page 797, and 1900, page 185.

Report upon survey of 1852 was made in October, 1853, and references to examinations and surveys may be found in the Annual Report of the Chief of Engineers for 1905, pages 153-154.

Sketches of Shrewsbury River are printed in the Annual Reports of the Chief of Engineers for 1879, 1881, 1882, 1887, 1890, 1891, 1892, and 1893, and maps of the whole river are printed in House Document No. 123, Fifty-eighth Congress, second session, and in Annual Report of the Chief of Engineers for 1905, page 1054.

July 1, 1906, balance unexpended.....	\$20,430.42
Amount appropriated by river and harbor act approved March 2, 1907..	10,000.00

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30,430.42

June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	7,448.97
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July 1, 1907, balance unexpended.....	22,981.45
July 1, 1907, outstanding liabilities.....	2,249.56

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July 1, 1907, balance available.....	20,731.89
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July 1, 1907, amount covered by uncompleted contracts.....	6,816.92
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(See Appendix G 6.)

7. *Manasquan River, New Jersey.*—This is a small stream in the eastern part of New Jersey which empties into the Atlantic Ocean about 26 miles south of Sandy Hook; in its natural condition the low-water depth for several miles above the mouth varied from 4 to 6 feet. The outlet, however, was obstructed by a shifting sand bar, on which the depth did not exceed 1½ feet. After severe storms this outlet was sometimes entirely closed, remaining so until sufficient fresh water had accumulated in the river above to force an outlet into the ocean.

A project for its improvement, adopted by the river and harbor act of March 3, 1879, based on examination and survey as printed in

Annual Report of the Chief of Engineers for 1879, pages 463-466, contemplated obtaining a permanent outlet for the river nearly at right angles to the shore, with a depth of 6 feet at mean low water; also dredging a channel in the lower river to the same depth. The estimated cost was \$52,120. Work was suspended in 1883, after three appropriations, amounting to \$39,000, had been expended on the improvement in the construction of two training dikes 1,515 and 475 feet long, respectively.

The existing project, approved March 3, 1899, with subsequent modifications, which is a modification of the original project, contemplates obtaining an outlet 6 feet deep for the river, and also in deepening the channel just above the mouth to the same depth, at an additional cost of \$18,300 over the amount expended and on hand, making the total estimated cost of the improvement \$59,300, to which should be added \$1,075 expended for maintenance.

The amount expended to June 30, 1907, was \$41,023.36, of which \$39,000 was used for carrying out the project and \$2,023.36 for maintenance.

This improvement, under present project, is about half completed.

References to examinations and surveys of the inlet are noted in the Annual Report of the Chief of Engineers for 1898, page 1070.

During the past fiscal year no work has been done on this improvement.

The maximum draft that could be carried June 30, 1907 was about 2 feet at mean low water. Mean range of tides, 2.4 feet.

The commerce amounts practically to nothing. The river is used principally by small fishing craft; also by pleasure boats during the summer season.

The improvement has not advanced to a condition which would affect the rates of freight. It is stated that there will be a reduction when the entrance is made navigable.

It is proposed to apply the available balance to the maintenance of the improvement.

Detailed descriptions of this improvement and histories of the work and maps are printed in the Annual Reports of the Chief of Engineers for 1880, Part 1, pages 547-556; 1882, Part 1, page 701; 1898, page 1070, and 1905, page 1056.

July 1, 1906, balance unexpended.....	\$4,995.29
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	18.65

July 1, 1907, balance unexpended.....	4,976.64
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Amount (estimated) required for completion of existing project....	14,375.00
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(See Appendix G 7.)

8. *Removing sunken vessels or craft obstructing or endangering navigation.*—(a) *Wreck of wooden hulk in Raritan Bay, near Lorillard, N. J.*—This wreck was found to be a sunken hulk, just awash at low tide and a menace to navigation. It has been partially blown to pieces, but has not as yet been wholly removed.

(b) *Wreck of canal boat "Geo. H. Notter" in Kill van Kull, N. Y. and N. J.*—This wreck, loaded with soft coal, was found to be sunk in water 30 feet deep and a dangerous obstruction to navigation. The wreck and cargo were removed and disposed of on February 16.

Pieces of the stern still remaining were removed and disposed of on February 21. The amount expended for the removal of this wreck was \$677.78.

(See Appendix G 8.)

EXAMINATIONS AND SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF MARCH 3, 1905.

Reports on preliminary examinations required by the river and harbor act approved March 3, 1905, of the following localities within this district were duly submitted by the district officer. They were reviewed by the Board of Engineers for Rivers and Harbors, pursuant to law, and were transmitted to Congress and printed in documents as indicated:

1. *Preliminary examination of Atlantic Highlands, New Jersey, with a view to the location of a breakwater.*—Report dated April 13, 1906, is printed in House Document No. 85, Fifty-ninth Congress, second session. It is not deemed advisable for the United States to undertake this improvement.

2. *Preliminary examination of New York Bay from Kill van Kull to a point in the vicinity of Bedloe (Liberty) Island west of Robbins reef light-house, with a view to a 21-foot channel of sufficient width.*—Report dated April 25, 1906, is printed in House Document No. 273, Fifty-ninth Congress, second session. It is not deemed advisable to undertake this improvement.

3. *Preliminary examination and plan and estimate of cost of improvement of Old South River, New Jersey.*—Reports dated January 27 and December 6, 1906, are printed in House Document No. 333, Fifty-ninth Congress, second session. A plan for improvement, at an estimated cost of \$20,908.80, is presented.

4. *Preliminary examination and survey of channel in Newark Bay, New Jersey, and Kill van Kull, north of Shooters Island to the existing channel near Corner Stake light, including the reef at Bergen Point light, with a view to obtaining a depth of 16 feet.*—Reports dated January 26 and December 6, 1906, are printed in House Document No. 337, Fifty-ninth Congress, second session, and a plan for improvement at an estimated cost of \$280,115, with \$5,000 annually for maintenance after completion, is presented.

5. *Preliminary examination and survey of Newark Bay and Passaic River, New Jersey, from Staten Island Sound to the Montclair and Greenwood Lake Railroad bridge, with a view to providing increased depth and width.*—Reports dated January 18 and December 28, 1906, are printed in House Document No. 441, Fifty-ninth Congress, second session. A plan for improvement at an estimated cost of \$1,216,775, approximately, is presented.

IMPROVEMENT OF DELAWARE RIVER, NEW JERSEY, PENNSYLVANIA, AND DELAWARE, AND OF CERTAIN WORKS IN DELAWARE BAY, DELAWARE.

This district was in the charge of Maj. J. C. Sanford, Corps of Engineers, from July 1, 1906, to April 22, 1907, and from June 25 to June 30, 1907, and in the temporary charge of Maj. C. A. F. Flagler, Corps of Engineers, from April 22 to June 25 1907. Division

engineer, Col. Amos Stickney, Corps of Engineers, to June 4, 1907, and Col. D. W. Lockwood, Corps of Engineers, since June 4, 1907.

1. *Delaware River, New Jersey and Pennsylvania.*—Trenton, the head of natural and actual navigation of the Delaware River, is about 30 miles above the upper end of the port of Philadelphia. In its original condition this stretch of river was obstructed by several shoals. Between Bordentown and Trenton, a distance of about 5 miles, a narrow and circuitous channel existed which carried only from 3 to 6 feet at mean low water. At Kinkora bar, about 9 miles below Trenton, there was a shoal carrying  $7\frac{1}{2}$  feet, and at Fivemile bar, opposite the upper part of Philadelphia, a shoal crossed the Pennsylvania channel carrying only 3 to 4 feet at mean low water. There was, however, a depth of 13 feet past Fivemile bar in the New Jersey channel south of Petty Island.

Below Philadelphia the river in its original condition presented obstructions at Mifflin bar which reduced the depth at mean low water to 17 feet, at Schooner ledge and Cherry Island flats to 18 feet, at Bulkhead shoal and Baker shoal to about 20 feet, and at Duck Creek flats to about 20 feet. The lower end of Duck Creek flats is 56 miles below Philadelphia.

In that part of the Delaware River between Trenton, N. J., and Bridesburg, Pa., efforts in the past have been directed toward relieving commerce from the obstructions which exist in the upper 9 miles of the river and toward deepening the channels across Perriwig and Kinkora bars.

Previous to 1885 the efforts to improve the river between Philadelphia and the bay were confined to dredging, except at Schooner ledge, where solid rock was removed. The work was done under appropriations for special localities, and also under general appropriations for the Delaware River below Bridesburg.

A Board of Engineers, convened by direction of the Secretary of War for the purpose of considering the subject of the permanent improvement of Delaware River and Bay, recommended, in a project dated January 23, 1885, and adopted in that year, the formation of a ship channel from a point opposite Philadelphia and about midway between the American Ship Building Company's yard and the Gas Trust wharf to deep water in Delaware Bay, having a least depth of 600 feet and a depth of 26 feet at mean low water. The formation of such a channel was to be obtained, except at Schooner ledge, where rock would have to be removed, by regulating the tidal flow by means of dikes, with recourse to dredging where necessary, as an aid to such contracting and regulating works.

The estimated cost of obtaining a channel of the above dimensions was about \$2,425,000, which covered the estimated cost of the permanent improvement of the Delaware River between the upper part of Philadelphia and deep water in the bay. The annual cost of maintenance was estimated at 10 per cent of the original cost for dredging and 1 per cent of the original cost for dikes. This estimate of cost did not include the improvement of Philadelphia Harbor, which was a separate project.

In the river and harbor act approved March 3, 1899, Congress adopted a new project for the improvement of the river, providing for the formation of a channel 600 feet wide and 30 feet deep from

Christian street, Philadelphia, to deep water in Delaware Bay, at an estimated cost of \$5,810,000. This project superseded the project of 1885. At the time of adoption of the new project the 26-foot channel, with widths varying from 200 to 600 feet, had been formed from the upper part of Philadelphia Harbor to the bay, except at the following-named localities: Tinicum Island shoal, depth from 23.6 feet to 26 feet over a distance of about 4,200 feet; above Schooner ledge, depth from 24 feet to 26 feet over a distance of about 4,800 feet; from below Marcushook to Bellevue, depth from 23 to 26 feet over a distance of about 13,500 feet. These distances are measured on the range lines. The distances measured between the 26-foot curves on the lines of deepest water were much shorter.

Part of the 26-foot channel above Marcushook, Pa., was dredged by the city of Philadelphia under the supervision of this office, with money appropriated by the city of Philadelphia.

At the same time there was between Trenton and Philadelphia a channel 6 feet deep at mean low water through Perriwig bar, a depth of 7 feet in the eastern channel at Bordentown, a channel 8½ feet deep through Kinkora bar, and a channel 26 feet deep over the whole width through Fivemile bar.

The total amount expended on the 26-foot project since its adoption, in 1885, was \$1,532,688.81, of which about \$200,000 is estimated to have been applied to maintenance. In addition to this expenditure the following sums were expended since the adoption of the 26-foot channel, in 1885, on special localities on the river under appropriations made for the purpose:

Channel across Smiths Island bar, between Philadelphia, Pa., and Camden, N. J.-----	\$30,000.00
Between the upper part of Philadelphia, Pa., and Trenton, N. J.-----	37,500.00
Rebuilding and enlarging dike at junction of Schuylkill and Delaware rivers-----	3,000.00
Removing rock ledge opposite Petty Island-----	69,463.26
Expenses of Board of Engineer officers on project for channel 30 feet deep and 600 feet wide-----	7,000.00
Total-----	146,963.26

The entire amount expended on the improvement of the Delaware River from 1836 to June 30, 1907, under appropriations for special localities and the general river improvement, not including Philadelphia Harbor, was \$7,968,202.70, of which \$124,500 was expended on the part of the river between Trenton and Philadelphia and \$8,710.17 for maintenance.

Work under the existing project was commenced under an appropriation of \$300,000 contained in the river and harbor act of March 3, 1899, and has been prosecuted under this and subsequent acts. Under the provisions of this act \$69,463.26 was applied to the improvement of the river between Trenton and Christian street, \$7,000 to the expenses of the Board of Engineer officers on project for a 30-foot channel, and the balance, \$223,536.74, under the existing project.

The river and harbor act approved June 13, 1902, appropriated the sum of \$600,000 for continuing this improvement under the existing general project, and authorized the letting of a contract or contracts to the extent of \$2,400,000 additional. The work completed during



the fiscal year ending June 30, 1905, under the contracts entered into and by the operation of the plant belonging to the United States, was done under this authority. The entire amount authorized by the act to be contracted for was appropriated.

The river and harbor act approved March 3, 1905, appropriated the sum of \$500,000 for continuing this improvement under the existing general project, and authorized the letting of a contract or contracts to the extent of \$1,000,000 additional. The work in progress during the past fiscal year was done under this authority.

The sundry civil act approved June 30, 1906, appropriated the sum of \$1,000,000 for continuing the improvement in completion of this contract authorization.

The river and harbor act approved March 2, 1907, appropriated the sum of \$895,000 for completing this improvement and authorized the letting of contracts to the extent of \$500,000 additional for maintenance of the dredged channel, this amount (yet to be appropriated) to be available, however, for use in completion of the project.

Of this appropriation the sum of \$40,000 is to be applied to maintenance of the dredged waterway in Philadelphia Harbor above Christian street, Philadelphia.

Up to the close of the fiscal year ending June 30, 1907, the sum of \$4,936,550.63 was expended on the work of the existing project in surveys, in dredging at Duck Creek flats, Baker shoal, Salem Cove flats, Deep Water Point, Cherry Island flats, Schooner ledge rock area, Tinicum and Mifflin bar shoals, and in the construction of bulkheads for the reception of dredged material and to act as training walls to direct the currents.

At Baker shoal the work of bulkhead construction has resulted in the completion of 30,627 linear feet of structure. At Cherry Island flats the work of bulkhead construction has resulted in the completion of 4,535 linear feet of structure. The work of dredging under the 30-foot project resulted in the formation of a channel 30 feet deep at mean low water, about 20,500 feet long, and with an average width of 600 feet through the upper part of Baker shoal; a channel of the same depth, with length of 43,000 feet, and 600 feet in width through Duck Creek flat shoal, and a channel of the same depth and 600 feet in width for a distance of 12,500 feet through Salem Cove flats shoal. The work of dredging through the shoals between Finns Point and the south line of Pennsylvania, in section 3, subsections A and B, section 4, subsections A and B, and section 5, subsection A, has resulted in the formation of a channel 30 feet deep at mean low water, about 70,200 feet long, and with a width of from 240 to 550 feet. The channel through Tinicum Island flats, Mifflin bar, and the shoal opposite Port Richmond has been deepened and improved by Government dredges.

The work of rock removal at Schooner ledge is now about 60 per cent completed.

The greatest draft of water that could be carried at mean low water on June 30, 1907, over the shoalest part of the river below Philadelphia was about 23.1 feet on center line of channel on the Schooner ledge light-house range opposite Chester, Pa. The dredging of this part of the channel to 30 feet depth has recently been begun.

It is proposed to apply the available and authorized funds to completion of the project and maintenance of the dredged channel. This will include widening of the channel beyond 600 feet at the bends below Philadelphia, as well as dredging in subsections 3A, 3B, 4A, 4B, and 5A to obtain the project width, completion of rock removal at Schooner ledge, and surveys, engineering and office expenses under the general project, the work to be done by contract or by hired labor and Government plant, as may be to the best interest of the United States.

In 1905 the State of Pennsylvania and the city of Philadelphia appropriated sums aggregating \$750,000 to be expended in accordance with the general project on that part of the river between the south line of Pennsylvania and the city of Philadelphia. This money is to be expended by the city of Philadelphia, and the work to be done is to be under the supervision of the United States engineer officer in charge of the improvement.

Under date of July 27, 1906, the United States entered into an agreement with the city of Philadelphia whereby Government plant should be placed on the work in sections 7 and 8 and operated under the direction of this office; all cost of the work to be paid by the city of Philadelphia. The city further entered into a contract with the American Dredging Company, under date of October 27, 1906, for the dredging of the entire channel to full width and depth in sections 6A, 6B, and 9 for a lump sum in each case.

Work under the above agreement with Government plant in sections 7 and 8 has resulted in a channel through Tinicum Island flats 29 to 30 feet deep and from 130 to 600 feet in width, and a similar channel through Mifflin bar shoal varying in width from 280 to 600 feet.

The contract dredging has resulted so far in a channel of the required depth and width of 600 feet in subsection 6A and of 50 to 250 feet in subsection 6B.

For 1890 the total foreign freight movement of the Delaware River was estimated at 2,923,994 tons and the total domestic freight movement at 8,433,276 tons; total, 11,356,270 tons. For 1906 the total foreign freight movement was estimated at 5,533,930 tons and the total domestic freight movement at 20,577,117 tons; total, 26,111,047 tons.

During the past fiscal year the following sums were derived from the sources stated and credited to the appropriation for this improvement:

On account of U. S. dredge <i>Delaware</i> , for services in the Wilmington, N. C., district.....	\$1,303. 87
On account of sales of United States property.....	660. 00
On account of sales of blueprints.....	11. 98
Total.....	1,975. 85

## COMMERCIAL STATISTICS.

The following statement concerning the foreign commerce of the Delaware River for the years ending December 31, 1905 and 1906, is compiled from the reports of the board of trade of the city of Philadelphia:

Articles.	1905.	1906.
<b>IMPORTS.</b>		
	<i>Tons.</i>	<i>Tons.</i>
Clay.....	58,719	213,206
Drugs and chemicals.....	118,104	31,235
Hemp, jute, flax, and their fabrics.....	31,000	68,333
Iron, manufactured.....	20,790	377,241
Iron ore.....	299,841	255,057
Sugar.....	252,118	787,803
Miscellaneous.....	584,670	
Total.....	1,865,245	1,732,935
<b>EXPORTS.</b>		
Coal.....	749,900	642,249
Grain and flour.....	365,692	843,019
Petroleum and products.....	1,242,824	1,209,642
Miscellaneous.....	909,023	1,606,085
Total.....	3,267,439	3,800,995

The following statement concerning the domestic and coastwise commerce of the Delaware River for the years ending December 31, 1905 and 1906, has been compiled from returns made by shippers, consignees, and carriers:

Articles.	1905.		1906.	
	Tons.	Value.	Tons.	Value.
<b>ARRIVALS.</b>				
Chemicals.....	104,033	\$4,142,055	164,818	\$3,794,174
Coal.....	611,218	1,761,913	617,089	2,236,895
Lumber.....	903,068	9,310,598	857,713	13,652,523
Sand.....	1,779,712	951,912	2,052,441	1,338,378
Miscellaneous.....	5,147,104	799,313,529	4,656,566	670,781,019
Total.....	8,545,135	815,480,007	8,348,627	691,802,959
<b>DEPARTURES.</b>				
Chemicals.....	103,572	2,598,496	79,644	2,191,711
Coal.....	7,694,946	30,402,184	7,730,543	27,206,621
Fertilizers.....	94,373	1,586,274	110,981	2,335,920
Iron, manufactured.....	76,546	2,192,994	76,239	2,549,832
Miscellaneous.....	4,236,315	622,028,619	4,231,133	586,039,298
Total.....	12,205,752	658,808,567	12,228,490	620,323,382

July 1, 1906, balance unexpended.....	\$1, 194, 625. 75
June 30, 1907, credited to appropriation during fiscal year: Sales of condemned property, \$660; sales of blueprints, \$11.98; account services of U. S. dredge <i>Delaware</i> in Wilmington, N. C. district, \$1,303.87; total.....	1, 975. 85
Amount appropriated by river and harbor act approved March 2, 1907 .....	895, 000. 00
	2, 091, 601. 60
June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$1, 049, 633. 28
For maintenance of improvement.....	8, 710. 17
	1, 058, 343. 45
July 1, 1907, balance unexpended.....	1, 033, 258. 15
July 1, 1907, outstanding liabilities.....	90, 613. 26
• July 1, 1907, balance available.....	942, 644. 89
July 1, 1907, amount covered by uncompleted contracts.....	200, 774. 80
Amount (estimated) required for completion of existing project..	500, 000. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for maintenance of improvement, in addition to the balance unexpended July 1, 1907.....	500, 000. 00
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

(See Appendix H 1.)

2. *Perriwig bar, Delaware River.*—The project for this improvement was adopted March 2, 1907, and provides for dredging a channel 7 feet deep at mean low water with a bottom width of 200 feet, in three straight stretches through Perriwig bar, at estimated cost of \$50,000. This sum was appropriated in the river and harbor act of March 2, 1907, for completing the improvement.

During the past fiscal year a new survey was made of the locality, and specifications were prepared with the view to advertising for proposals for the work to be done. In this work to the close of the year the sum of \$530.29 had been expended.

The plan of improvement is printed in House Document No. 852, Fifty-ninth Congress, first session.

Amount appropriated by river and harbor act approved March 2, 1907..	\$50, 000. 00
June 30, 1907, amount expended during fiscal year, for works of improvement .....	530. 29

July 1, 1907, balance unexpended.....	49, 469. 71
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(See Appendix H 2.)

3. *Harbor between Philadelphia, Pa., and Camden, N. J.*—The project for this improvement was adopted in 1888, and was completed in 1898 at a total cost of \$3,934,912.76. The final report upon completion of the work is printed in the Annual Report of the Chief of Engineers for 1899, page 1330.

The commercial statistics pertaining to this harbor are included in the statistics accompanying the report for the improvement of Delaware River.

Under date of April 5, 1906, the Secretary of War allotted the sum of \$10,000 from the emergency appropriation of \$300,000, carried by the river and harbor act approved March 3, 1905, for the restoration

of channels or river and harbor improvements heretofore established or made by the Government, to be applied to removal, by dredging, of shoal places within the limits of the channel previously dredged by the United States under the completed project for the improvement of this harbor. These shoal places were found to exist in the channel of the harbor at localities lying principally between Allegheny avenue and Moore street, Philadelphia. The \$10,000 was for expenditure in dredging a portion of this shoaling by the use of the U. S. dredge *Delaware*, constructed for work on the Delaware River.

This work was completed in July, 1906, by the U. S. dredge *Delaware* in the removal of 10,968 cubic yards of material. In the fiscal year 1906 this dredge removed 98,432 cubic yards, making the total quantity of material removed under the allotment 109,400 cubic yards, which was pumped ashore at Mifflin bar by the United States rehandling machine *Cataract*. The total cost of this work to June 30, 1907, was \$9,977.27. The sum of \$7.06, remaining from the allotment was redeposited to the credit of the appropriation.

It is understood that the appropriation made in the river and harbor act approved March 2, 1907, and the additional amount authorized by the same act for improving Delaware River, New Jersey, Pennsylvania, and Delaware, completing improvement, is available for maintenance of the previously dredged channel along the Philadelphia water front above Christian street.

July 1, 1906, balance unexpended from allotment of \$10,000 from appropriation for emergencies in river and harbor works, act of March 3, 1905		
June 30, 1907, amount expended during fiscal year:		\$7,292.70
For maintenance of improvement	\$7,269.97	
Returned to Treasury	7.06	
		<hr/> 7,277.03
July 1, 1907, balance unexpended		15.67
July 1, 1907, outstanding liabilities		15.67

(See Appendix H 3.)

4. *Ice harbor at Marcushook, Pa.*—In 1785 the Commonwealth of Pennsylvania built two wharves upon crib piers at Marcushook for the convenience of commerce. In 1829 an appropriation was made by Congress for repairing the piers and improving the harbor.

In 1866 a project was adopted for a harbor in Delaware River to protect vessels against moving ice. The old work at Marcushook was utilized as far as possible. The amount expended from 1866 to June 30, 1907, was \$213,962.46. Since 1899 all expenditures have been for repairs and maintenance. The last amount appropriated for the work was \$5,000, by act of September 19, 1890.

The harbor covers an area of 12 acres, of which about one-half has a depth of 12 to 18 feet and the other half 18 to 25 feet at mean low water. The protection consists of the old landing piers and seven detached piers, having foundations of wooden cribs filled with stone, the superstructures being faced with cut stone. The detached piers appear to be in good condition.

During the past fiscal year no work was in progress.

Rules for the use of the landing piers were approved by the Acting Secretary of War under date of April 29, 1904.

July 1, 1906, balance unexpended	-----	\$37. 54
July 1, 1907, balance unexpended	-----	37. 54

(See Appendix H 4.)

5. *Iron pier in Delaware Bay, near Lewes, Del.*—The original project for this work proposed the construction of a landing pier about 1,700 feet in length, extending from the shore south of the breakwater into Delaware Bay to a depth of 22 feet at mean low water, the pier to consist of a substructure of wrought-iron screw piles, surmounted by a timber superstructure. The work was commenced in 1871 and completed, except as to superstructure, in 1880.

The work done to June 30, 1890, resulted in the construction of 1,155 linear feet of pier 21 feet in width and 546 linear feet 42 feet in width, or a total length of 1,701 feet. The depth of water at the outer end of the pierhead was about 21 feet at mean low water. Since construction the pier has been repaired and cared for by the United States.

The total expenditures to June 30, 1907, were \$385,339.40. Of this amount, \$27,000 was applied to the maintenance of the improvement.

The right to use the pier for railway purposes, granted in the act of July 15, 1870, has never been exercised, and doubtless never will be, as the pier has not sufficient strength to support the weight of modern freight engines. It is therefore impossible to obtain any assistance from the railroad company in maintaining and repairing the structure.

During the past fiscal year no work was in progress.

The pier is of great use for the purposes of the Government engineer, light-house, and quarantine services. It is of very great value to vessels frequenting the breakwater harbor in winter, when the harbor is packed with floating ice, rendering the anchorage dangerous. At such times vessels eagerly seek its shelter and protection.

It is proposed to hold the available balance of \$820.60 for maintenance and repairs as needed.

The mean range of tide at the pier is 4.5 feet.

July 1, 1906, balance unexpended	-----	\$820. 60
July 1, 1907, balance unexpended	-----	820. 60

(See Appendix H 5.)

6. *Delaware Breakwater, Delaware.*—The final report of the local officer upon this work was submitted June 19, 1899, and is printed in the Annual Report of the Chief of Engineers for 1899, page 1346.

The depths in the protected anchorage vary from 11½ to 18 feet at mean low water, and the harbor is available for vessels drawing up to about 16 feet.

The amount expended on this work up to June 30, 1907, was \$2,807,479.06. No portion of this amount has been applied to maintenance.

During the fiscal year ending June 30, 1903, a survey of the breakwater harbor was completed as a part of a survey of the national harbor of refuge.

The mean range of tide is 4.5 feet.

It is proposed to reserve the available balance of \$875.64 for repairs to the breakwater and for surveys and examinations of the work.

July 1, 1906, balance unexpended.....	\$875.64
July 1, 1907, balance unexpended.....	875.64

(See Appendix H 6.)

7. *Harbor of refuge, Delaware Bay, Delaware.*—The project for the construction of this harbor, which was adopted and provided for under the continuous-contract system in the river and harbor act of June 3, 1896, includes the construction of a breakwater on the line of least depth along the eastern branch of the shoal known as the "Shears," and the construction of a row of ice piers across the upper end of the harbor to protect it from ice descending the bay, at a total cost not to exceed \$4,665,000.

No expenditures were made on this improvement previous to June 30, 1896.

Up to the close of the fiscal year ending June 30, 1907, \$2,238,205.34, had been expended in the construction of the breakwater and ice piers.

No part of this amount was applied to the maintenance of the work.

During the fiscal year ending June 30, 1904, the sum of \$338.43 was expended on a survey made of the harbor.

The breakwater was completed on December 11, 1901. The superstructure of the breakwater has a length of 7,950 feet and the substructure a length of 8,040 feet, measured on the low-water line.

A project for the construction of 10 ice piers was submitted on April 5 and approved April 23, 1900. This work was commenced during the fiscal year ending June 30, 1901, and completed November 22, 1902. Seventy-one thousand three hundred tons of stone was deposited in the work.

A project for the construction of additional ice piers was submitted under date of June 7 and approved June 30, 1902. Work under this project was begun August 4, 1902, and completed June 19, 1903. Thirty-seven thousand six hundred and seventy-three tons of stone was deposited, completing 5 ice piers.

A report was submitted under date of November 19, 1902, containing project and estimates for further protection of the harbor. A further report on this subject, containing a detailed project and estimate of cost of the proposed extension of the breakwater at this harbor, was submitted under date of November 14, 1903. Both reports and the recommendations of the Board of Engineers for Rivers and Harbors are published in House Document No. 548, Fifty-eighth Congress, second session, and also contained in the Annual Report of the Chief of Engineers for 1904, pages 1215-1225.

It is proposed to reserve the available balance of \$1,128.66 for repairs and surveys and examinations of the work.

The great value of this harbor to commerce is due to its location. It is about equidistant from New York, Philadelphia, and the capes of Chesapeake Bay (the ocean entrance for the ports of Baltimore, Norfolk, and Newport News), and is therefore an especially convenient port of call for the entire commerce of the North Atlantic coast. It is now largely used by vessels awaiting orders to ports for discharge or loading. During the year ending December 31, 1905, 1,013 vessels (not including small craft) called at this harbor.

By the construction of the breakwater the usefulness of this anchorage has been greatly increased, not only as a port of call but also as a harbor of refuge. Vessels bound from northern to southern or from southern to northern ports are able to go to sea in doubtful weather with the assurance of finding ample protection at the Delaware capes if overtaken by storm.

Details as to this improvement may be found in the Annual Report of the Chief of Engineers for 1897, page 1216. A map is printed in House Executive Document No. 112, Fifty-second Congress, first session.

The mean range of tide is 4.5 feet.

July 1, 1906, balance unexpended	\$1, 128. 66
July 1, 1907, balance unexpended	1, 128. 66

(See Appendix H 7.)

8. *Removing sunken vessels or craft obstructing or endangering navigation.*—(a) *Wreck of barge Alice in Delaware River near Tinicum Island.*—This wreck was considered an obstruction to navigation; its removal was authorized on June 30, 1904. The wreck has not yet been removed. It is proposed to do the work of removal by the use of plant belonging to the United States.

(b) *Wreck of a ponton in the eastern channel of the Delaware River off Gloucester, N. J.*—This wreck being considered a dangerous obstruction to navigation, its removal was authorized under date of February 23, 1906. Sealed proposals for its removal were received and opened on March 12, 1906, but rejected, the prices being considered too high. It was therefore decided to remove it with Government plant, which work was completed August 9, 1906. The total cost of its removal was \$457.01.

(c) *Wreck of unknown canal boat in Delaware River at New Castle, Del.*—This wreck being considered a dangerous obstruction to navigation, its removal was authorized under date of June 20, 1906. The removal of this wreck by contract was completed July 21, 1906. The total cost of removal was \$385.05.

(d) *Wreck of schooner Hampton in Delaware Bay off Fortescue Beach, New Jersey.*—This wreck being considered a dangerous obstruction to navigation, removal was authorized under date of August 2, 1906. The work of removal by contract was completed September 28, 1906, at a total cost of \$399.83.

The total amount expended during the past fiscal year upon removal of wrecks was \$1,264.08.

(See Appendix H 8.)

#### IMPROVEMENT OF RIVERS AND HARBORS IN SOUTHERN NEW JERSEY AND OF CERTAIN RIVERS AND HARBORS IN DELAWARE.

This district was in the charge of Maj. C. A. F. Flagler, Corps of Engineers. Division engineer, Col. Amos Stickney, Corps of Engineers, to June 4, 1907, and Col. D. W. Lockwood, Corps of Engineers, since that date.

1. *Rancocas River, New Jersey.*—The Rancocas River is a tributary of the Delaware River, its mouth being about 11 miles above the Pennsylvania Railroad terminal and ferry at Camden, N. J.



In its original condition the minimum depth was  $4\frac{1}{2}$  feet at mean low water from the junction of the forks near Centerton to its mouth, a distance of  $7\frac{1}{2}$  miles. Above Centerton the depth on the Mount Holly Branch, a distance of  $5\frac{1}{2}$  miles, was generally about  $2\frac{1}{2}$  feet. From the forks to Moores Landing, the head of navigation on the Lumberton Branch, a distance of 3.6 miles, the low-water depth over shoal places was 3 feet. The mean range of tides at Centerton is about 5 feet.

The original project, which was adopted by Congress in the act of March 3, 1881, proposed the formation, by a dike at Coates bar, and dredging elsewhere, of a channel from 150 to 200 feet wide and 6 feet deep at mean low water from the mouth to Centerton and thence to Mount Holly, a channel 5 feet deep. Operations under this project were carried on from 1881 to 1895, and were directed to the formation of a low-water channel 100 feet wide and 6 feet deep from the mouth to Centerton and 50 feet wide and 5 feet deep for a distance of about  $1\frac{3}{4}$  miles above Centerton.

An appropriation of \$2,000 for this river, made in the act of June 3, 1896, was required by the act to be expended in the improvement of the Lumberton Branch and was applied in the fiscal year 1898 to dredging, and an appropriation of \$2,000 made in the river and harbor act of March 3, 1899, was likewise required to be expended in the Lumberton Branch and was applied to dredging.

The river and harbor act of June 13, 1902, appropriated \$3,000 for continuing the improvement of the Lumberton Branch, and with this appropriation contraction works, consisting of low wing dams, were built and placed in 1903 at points along the river where the channel had been dredged and had refilled.

No work was done during the past fiscal year.

The amount expended on this improvement to June 30, 1907, is \$44,479.45, of which \$6,979.24 was on the Lumberton Branch. No part of these expenditures was for maintenance.

The maximum draft that could be carried June 30, 1907, at mean low water, over the shoalest part of the river between the mouth and the "Forks" and Centerton, was 5 feet.

It has been impracticable to ascertain what direct effect the improvement of the channel has had upon freight rates or the extent of the commerce during the past year. For 1903 the commerce reported was 462,971 tons, valued at \$9,634,550.

July 1, 1906, balance unexpended.....	\$20. 76
July 1, 1907, balance unexpended.....	20. 76

(See Appendix I 1.)

2. *Cooper Creek, New Jersey.*—This creek enters the Delaware River in the city of Camden, just above Cooper Point. It was navigable at mean high water for a distance of 9 miles from its mouth for vessels drawing 5 feet, and for the first 5 miles for vessels of  $11\frac{1}{2}$  feet draft. The mean range of the tide at the mouth is about 6 feet. For a distance of  $1\frac{1}{2}$  miles from the mouth the width of the stream averaged about 80 feet at low water and about 120 feet between the banks, and the channel in its original condition had a depth at mean high water of from 12 to 15 feet, except at one place where the depth was  $9\frac{1}{2}$  feet.

The project for this improvement was adopted in the river and harbor act of June 3, 1896, and is printed in the Annual Report of the Chief of Engineers for 1895, page 1102. It provides for the formation, by dredging, of a channel 70 feet wide at bottom and 18 feet deep at mean high water from the mouth of the creek to Browning's Chemical Works and a channel of the same dimensions through the bar just outside the mouth—in all, a distance of about 9,000 feet. The estimated cost, including contingencies, is \$35,000.

The river and harbor act of June 3, 1896, appropriated \$37,000 for completing this improvement, of which \$2,500, or as much thereof as might be necessary, was to be expended in rebuilding the dike on the Government reservation in the Delaware River at Woodbury Creek.

During the fiscal year ending June 30, 1897, the sum of \$2,500 was expended in rebuilding the dike at Woodbury Creek referred to, and in 1898-99 the channel in Cooper Creek was dredged. This dredging resulted in the formation of a channel extending from the mouth to the Camden Iron Works, 7,500 feet long, 50 to 70 feet wide, except at the bridges, where the widths are 30 feet, and 18 feet deep at mean high water (12 feet at mean low water). At State street the depth made was only 14 to 15 feet on account of a city water main crossing the stream at that depth. Further operations were suspended to await the lowering of this pipe, which was contemplated by the city. To meet the wants of the traffic in the creek the channel was dredged in 1906 between the State Street Bridge and the 12-foot contour in the Delaware River to a depth of 12 feet at mean low water and a width of 70 feet.

It is proposed to complete the improvement to the extent of the funds available as soon as the city of Camden removes or lowers the water pipe at State street. Under a contract made by the city, operations for lowering the pipe are to begin in the early part of July, 1907.

The maximum draft that could be carried on June 30, 1907, at mean low water over the shoalest part of the channel was 12 feet from the Delaware River to State Street Bridge, thence 7 feet to the Camden Iron Works, and thence 5 feet to Browning's Chemical Works.

The amount expended to June 30, 1907, is \$30,970.76, exclusive of the \$2,500 expended in rebuilding the dike at Woodbury Creek. Of this amount \$5,294.66 was for maintenance.

It has been impracticable to procure complete commercial statistics, but so far as received the total tonnage of receipts and shipments on the creek for the calendar year ending December 31, 1906, was 264,539, valued at \$2,165,412.

The effect of the improvement made in this stream on freight rates is that it has reduced the rates by permitting larger vessels to be secured for long voyages, which was formerly impossible. The railroad rates to points in the United States east of Cape Cod are 25 per cent higher than by water.

July 1, 1906, balance unexpended.....	\$8, 602. 20
June 30, 1907, amount expended during fiscal year, for maintenance of improvement .....	5, 072. 96

July 1, 1907, balance unexpended.....	3, 529. 24
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Amount (estimated) required for completion of existing project.....	5, 072. 96
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(See Appendix I 2.)

3. *Mantua Creek, New Jersey.*—Mantua Creek is a stream flowing into the Delaware River at a point about 10 miles below the terminal and ferry of the Pennsylvania Railroad at Camden, N. J.

In its original condition it was navigable at high water for a distance of one-half mile above its mouth to the phosphate works of the I. P. Thomas & Sons Company for vessels of 13 feet draft; thence  $3\frac{1}{4}$  miles farther, to Paulsboro, for vessels drawing 9 feet; thence  $3\frac{1}{4}$  miles to Parkers Landing for tugs and barges drawing 6 feet, this being the head of steam navigation; thence 4.1 miles to Mantua,  $11\frac{1}{4}$  miles above the mouth, small boats and barges of 3 to 4 feet draft passed up on the tide. The navigable portion is generally bordered by low ground, protected from overflow by earthen banks. The general course of the stream is tortuous, and its navigation was much obstructed by bars, sharp bends, and the upper portion by stumps and overhanging trees. The stream, on account of its flat watershed, is subject to only moderate freshets, which seldom exceed 2 to 3 feet above tide water. The range of tide is 6 feet at the mouth, 4.5 feet at Paulsboro, 3.4 feet at Berkley, and 2 feet at Mantua, which is the head of navigation. The low-water width near the mouth averaged 160 feet, decreasing to about 100 feet at Paulsboro. Above Paulsboro the width decreased to 88 feet at Parkers Landing, and near Mantua to 50 feet.

The approved project for the improvement, which was adopted by Congress in river and harbor act of March 3, 1899, contemplates the dredging of a channel 100 feet wide on the bottom and 12 feet deep from the 12-foot contour in the Delaware River, through the marsh to the phosphate works, a distance of 2,200 feet; thence 80 feet wide on the bottom and 8 feet deep to Paulsboro, 6,300 feet, making a channel nearly direct by cutting off three bends; thence to Parkers Landing, near Berkley, 3 miles, with one cut-off 60 feet wide and 7 feet deep; and the dredging of a cut-off 350 feet long, 50 feet wide, and 3 feet deep, 9,000 feet above Berkley; also the removal of overhanging trees above Berkley and the construction of jetties on both sides at the mouth of the creek. The estimated cost of this improvement is \$145,030. Such lands and rights as were considered necessary for the cut-offs were purchased in September, 1900, at a cost of \$8,000. During the fiscal year ending June 30, 1901, the channel between the phosphate works and Paulsboro was dredged to the project dimensions and the three cut-offs made as planned, and between November, 1903, and January, 1905, a channel 12 feet deep at mean low water was dredged direct from the 12-foot contour in the Delaware River to the phosphate works, cutting off the old mouth, the width made being 110 feet across the flats and 100 feet at the upper and lower ends of this dredging.

Work for the protection of the channel at the new mouth to the extent of the available funds was begun on November 8, 1906, under a contract for jetty and dike construction, and to the end of the fiscal year 307 linear feet of jetty had been built on the east side of the entrance to the creek and 301 feet on the west side; also 186 feet of dike to close a gap in the bank of dredged material, just inside of the entrance.

The amount expended on the improvement to June 30, 1907, is \$59,599.68, of which \$56,599.68 is on the present project. No expendi-

ture has yet been made for maintenance. About three-fifths of the work on the project remains to be done.

The river and harbor act of March 2, 1907, appropriated \$34,450 for continuing the improvement and authorized a sufficient amount thereof to be applied to the construction of a dike to close the old mouth of the creek. These funds it is proposed to apply to the completion of the jetties and the construction of the dike referred to, and thereafter to redredge the channel where needed with the funds remaining on hand. Proposals for the jetty and dike construction were opened on June 21, 1907, and contract awarded. It is expected that the work will be begun shortly.

The maximum draft that could be carried on June 30, 1907, at mean low water over the shoalest part of the creek under improvement was 10 feet to the phosphate works, thence  $5\frac{1}{2}$  feet to Paulsboro, and thence  $2\frac{1}{2}$  feet to Parkers Landing.

The receipts and shipments for the calendar year 1906 are reported to have been 240,220 tons, valued at \$984,700.

The improvement of Mantua Creek is reported to have reduced freight rates on car floats by fully 25 per cent, and has greatly facilitated shipments.

July 1, 1906, balance unexpended.....	\$15,564.54
Amount appropriated by river and harbor act approved March 2, 1907..	34,450.00
	<hr/>
	50,014.54
June 30, 1907, amount expended during fiscal year, for works of im- provement .....	12,164.22
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July 1, 1907, balance unexpended.....	37,850.32
July 1, 1907, outstanding liabilities.....	2,400.00
	<hr/>
July 1, 1907, balance available.....	35,450.32
	<hr/>
July 1, 1907, amount covered by uncompleted contracts.....	650.00
Amount (estimated) required for completion of existing project....	50,580.00
(See Appendix I 3.)	

4. *Raccoon Creek, New Jersey.*—This creek rises in Gloucester County, flows in a northwesterly direction, and empties into the Delaware River at a point nearly opposite Marcushook, Pa. A preliminary examination and survey of Raccoon Creek was made in 1899, and a report, with estimated cost of improvement, is printed in Annual Report of the Chief of Engineers for 1900, pages 1590–1598.

It was navigable at high water for a distance of three-fourths mile above its mouth to Bridgeport for vessels of 9 feet draft, thence  $3\frac{1}{4}$  miles farther to Springer's wharf for vessels drawing 7 feet, and thence  $4\frac{3}{4}$  miles to Swedesboro, the head of steam navigation for boats and barges having a draft of 4 feet. Above Swedesboro the stream was narrow, shoal, and very crooked. The navigable portion, when it left fast land, wound through meadows lying 2 or 3 feet above low water, which, except for the 2 miles immediately below Swedesboro, were generally protected from overflow by revetted earthen banks. Navigation was much obstructed by bars and a few sharp bends.

The range of tide varies from 6 feet at the confluence with the Delaware River to 4.9 feet at Swedesboro, where it is considerably influenced by winds and freshets.

The approved project, adopted by river and harbor act of June 13, 1902, proposes the formation of a dredged channel 7 feet deep and 75 feet in width at mean low water from the mouth for a distance of  $1\frac{3}{4}$  miles to Bridgeport, thence a channel of the same depth and 60 feet wide to Springer's wharf, and thence a channel 5 feet deep at mean low water and 40 feet in width to the head of navigation at Swedesboro,  $9\frac{3}{4}$  miles from its mouth, together with the widening of the channel around sharp bends, at an estimated cost of \$102,135. That act appropriated \$15,000, and between August, 1903, and March, 1904, a continuous channel was dredged from the mouth of the creek to the highway bridge at Bridgeport and thence across Springer's bar. The length improved was about 5 miles.

With an appropriation of \$15,000 in 1905, the channel between the Delaware River and Springer's wharf was redredged to the project dimensions, and above the latter point the channel was dredged to a depth of 5 feet at mean low water and a width of 40 feet to the head of navigation at Swedesboro. This completed about three-fourths of the project.

No work has been done on the improvement during the past fiscal year. The disbursements were for outstanding liabilities and examinations.

The river and harbor act of March 2, 1907, appropriated \$15,000 for continuing the improvement and for maintenance, and authorized a sufficient amount thereof to be applied to the making of a cut-off at Molonox shoal, with the proviso that no expenditure shall be made thereon until the land needed therefor shall have been deeded to the United States free of expense.

A project for the expenditure of the appropriation has been approved. This provides for making the proposed cut-off and redredging the channel where it has shoaled to its project dimensions from the Delaware River to Swedesboro, and this work is to be undertaken as soon as title is secured to the land required for the cut-off. Negotiations therefor are now in progress.

The amount expended on the improvement to June 30, 1907, is \$22,785.43, of which \$2,539.78 was for maintenance. This is exclusive of \$757.23 expended in 1882 for an examination under the river and harbor act of August 2, 1882.

The maximum draft that could be carried June 30, 1907, at mean low water, over the shoalest part of the creek, was 7 feet from Delaware Bay to Springer's and thence 5 feet to Swedesboro.

The improvement of the stream has so far had no marked effect upon freight rates, as sufficient time has not elapsed since the dredging was extended to Swedesboro. Bulky freight by water, however, costs only about half that by rail.

The commerce of the creek during the calendar year 1906, as reported, was 188,864 tons, valued at \$1,995,880.

The present project as estimated is complete except as to widening at bends and the construction of the cut-off at Molonox shoal, but the execution of the work has improved the stream by increasing the tidal range in the upper waters about 1 foot. To effect the provisions of the project it is therefore necessary to do additional dredging to secure the low-water depth provided.

July 1, 1906, balance unexpended.....	\$10,400. 78
Amount appropriated by river and harbor act approved March 2, 1907..	15,000. 00

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25,400. 78

June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$653. 66
For maintenance of improvement.....	289. 78

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943. 44

July 1, 1907, balance unexpended.....	24,457. 34
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Amount (estimated) required for completion of existing project....	57,135. 00
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(See Appendix I 4.)

5. *Salem River, New Jersey.*—In 1872 the upper part of this river was separated from the lower part by a dam and was connected with the Delaware River by a canal forming two independent streams with mouths about 10 miles apart.

Prior to the adoption of the present project \$17,209.34 had been expended on improvement of this stream, of which \$10,000 was applied to work in Salem Cove, at the natural mouth below Salem, with which a channel 8 feet deep and 100 feet wide at low water was obtained, and \$7,209.34 to improvement of the upper river in the formation of a channel 6 feet deep and 50 feet wide at mean low water up to Hoxies Landing.

The existing project was adopted by the river and harbor act of March 2, 1907, and is for improvement of the lower river below Salem by dredging a channel 100 feet wide and 9 feet deep at mean low water, amplifying at the bends so as to permit the passage of vessels 200 feet long from Delaware River up to the highway bridge over Little Salem Creek, including the removal of the stony bars in front of the city wharves and at the bend above the brickyard. The estimated cost of this work, as given by the Board of Engineers for Rivers and Harbors in report of January 16, 1907, is \$29,000.

The amount expended on the existing project to June 30, 1907, is \$318.79.

Report of survey on which the present project is based is printed in the Annual Report of the Chief of Engineers for 1897, page 1245, and report thereon by the Board of Engineers for Rivers and Harbors is printed in River and Harbor Committee Document No. 12, Fifty-ninth Congress, second session.

Amount appropriated by river and harbor act approved March 2, 1907..	\$29,000. 00
June 30, 1907, amount expended during fiscal year, for works of improvement .....	318. 79

July 1, 1907, balance unexpended.....	28,681. 21
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(See Appendix I 5.)

6. *Alloway Creek, New Jersey.*—This is a tidal tributary of the Delaware River, flowing westerly in the southwestern part of New Jersey, its mouth being about 50 miles below Camden, N. J. In its original condition the creek was obstructed between its mouth and Quinton, a distance of about 10 miles, by shoal areas in the upper half of the stream, which reduced the low-water depths to from 1.3 to 4 feet. The mean range of tide is 6 feet at the mouth and 4 feet at Quinton, the head of navigation.

The original project of 1889 proposed the formation by dredging of a channel 6 feet deep at mean low water and 60 feet wide from Quinton to a point about 1,000 feet above upper Hancock Bridge; thence a channel of the same depth and 75 feet wide to a locality known as "The Square," where the work was to be supplemented by a dike. At a locality known as the "Canal," in addition to a channel of the last-named dimensions, the width of the stream was to be increased to about 150 feet between its low-water lines. The project was modified on December 10, 1896, so as to provide for a dike formed by a single row of piles above upper Hancock Bridge. This modification did not increase the original estimated cost of the work, which is \$25,000.

At the close of the fiscal year ending June 30, 1900, \$18,000 had been expended in dredging and in dike construction. Channels from 40 to 75 feet wide and 6 feet deep at mean low water had been dredged at various localities, and dikes 300 and 404 feet in length, respectively, had been constructed at "The Square" and above upper Hancock Bridge.

In 1903, with the \$3,000 appropriated by the river and harbor act of June 13, 1902, the channel was dredged at various points between the upper end of a shoal just above Hancock Bridge and a point about 3 miles below, forming a continuous channel 6 feet deep at mean low water and 60 feet wide between the points named.

With an appropriation of \$3,000 in 1905 dredging was done with a hired dredge, resulting in a channel not less than 75 feet wide and 6 feet deep at mean low water from the mouth of the creek to a point about one-half mile below the highway bridge at Hancocks, a distance of 4.92 miles. This completed about three-fifths of the project.

No work was done during the past fiscal year.

The river and harbor act of March 2, 1907, appropriated \$5,000 for continuing improvement and maintenance, and authorized a sufficient amount thereof to be applied to the construction of a cut-off at Fosters Bottle, with the proviso that no expenditure shall be made thereon until all land needed for such cut-off shall be deeded to the United States free of expense.

A project for the expenditure of this appropriation under the conditions of the law has been approved by the Chief of Engineers, and at the close of the fiscal year work thereon is awaiting the result of negotiations for the acquisition of the land needed for the proposed cut-off.

The amount expended on the improvement to June 30, 1907, is \$23,553.37, of which \$7,064.35 was for maintenance.

The maximum draft that could be carried on June 30, 1907, at mean low water over the shoalest part of the locality under improvement to Quinton was 5 feet.

The commerce of the creek consists of miscellaneous articles, such as coal, sand, lumber, agricultural products, etc. The tonnage for the calendar year 1906 was 57,903, valued at \$1,162,750.

The freight rates are reported to have been lowered by reason of the improvement of the creek, but to what extent is not stated. Larger boats are enabled to enter and depart, and shipments have been facilitated very much by avoiding delays in waiting for tides.

July 1, 1906, balance unexpended-----	\$509.24
Amount appropriated by river and harbor act approved March 2, 1907-----	5,000.00
	<hr/> 5,509.24
June 30, 1907, amount expended during fiscal year, for maintenance of improvement-----	62.61
	<hr/> 5,446.63
July 1, 1907, balance unexpended-----	200.06
Amount (estimated) required for completion of existing project-----	
(See Appendix I 6.)	

7. *Cohansey River, New Jersey.*—In its original condition this river or creek was navigable to Bridgeton, 19 miles above the mouth, through a tortuous channel of ample depth. The obstructions to navigation were found at Bridgeton, where the city gas and water mains were laid at a depth of only 4 feet below low water, and at the mouth, where the river discharged into Delaware Bay across a soft mud bar without any well-defined channel. At Bridgeton there is a fixed bridge known as the Nail Works Bridge, and just above the bridge is a milldam which limits the tidal flow of the stream.

Prior to adoption of the present project \$36,000 had been expended in dredging a channel 7 feet deep at mean low water 70 to 90 feet wide to the Broad Street Bridge, 40 feet wide above to the Commerce Street Bridge, thence 4 feet deep to the Nail Works Bridge.

The present project is a new one. It was adopted in the river and harbor act of March 2, 1907, and provides for dredging a cut 100 feet wide and 7 feet deep at mean low water at the mouth, and for dredging a channel to the same depth in the river from Stony Point to the Nail Works Bridge, the widths to be 100 feet to Broad Street Bridge, thence 75 feet to the Commerce Street Bridge, and thence 60 feet to the Nail Works Bridge, at an estimated cost of \$55,800, which is the amount appropriated. The range of tides at Bridgeton is nearly 7 feet, which is practically all the present available depth along the wharves of that town.

To June 30, 1907, \$31.22 had been expended on the existing project.

The commerce, which was very large for years prior to 1884, was only about 16,800 tons in 1906, as reported, owing to the deterioration of the channel.

On June 26, 1907, proposals for the dredging required in the river were opened, and at the close of the fiscal year award of contract thereon was under consideration.

No work can be done at the mouth until title has been secured to a tract of land needed for a cut-off. Negotiations for the transfer to the United States of this land free of cost are now in progress and may be consummated soon.

The existing project is printed in House Document No. 645, Fifty-ninth Congress, first session.

Amount appropriated by river and harbor act approved March 2, 1907-----	\$55,800.00
June 30, 1907, amount expended during fiscal year, for works of im- provement-----	31.22
	<hr/> 55,768.78
July 1, 1907, balance unexpended-----	
(See Appendix I 7.)	



8. *Tuckerton Creek, New Jersey.*—This is a tidal stream flowing into Little Egg Harbor, on the Atlantic coast, northeast of Atlantic City. A preliminary examination and survey of the creek were made, and a report recommending its improvement is printed in Annual Report of the Chief of Engineers for 1900, pages 1612-1615.

The original low-water depth at Tuckerton, the head of navigation, was 15 inches, which increased gradually to 4 feet at the mouth of the creek, a distance of 2 miles. From the mouth of the creek across the flats to Gaunts Point, seven-eighths of a mile, the low-water depths were 2 to 2½ feet. The mean tidal range is 2½ feet. The project, adopted by the river and harbor act of June 13, 1902, contemplates the dredging of a channel 6 feet deep at mean low water and 80 feet wide from Gaunts Point, seven-eighths of a mile, to the mouth of the creek; thence a channel of the same depth and 75 feet wide, 1 mile, to Parkers Landing; thence a channel of the same depth and 60 feet wide, five-eighths of a mile farther, to West Tuckerton Landing; thence a channel 5 feet deep at mean low water and 60 feet wide for three-eighths of a mile to just above Scow Landing, and thence a channel 3 feet deep at mean low water and 40 feet wide for one-eighth of a mile to the milldam at Tuckerton, together with the widening of the channel at sharp bends; the channel across the cove between the mouth of the creek and Oyster Bed Point to be supplemented, if necessary, by a revetment wall along its northern side. The estimated cost of the work, including contingencies, is \$61,380. Under authority contained in the river and harbor act of March 3, 1905, the Secretary of War authorized the location of the channel at the mouth to be changed so as to lead it in a south-southeast direction directly to the deep water at the head of Marchelder channel instead of to Gaunts Point.

The act of June 13, 1902, appropriated \$12,000, and with this appropriation the channel was dredged, between May, 1903, and February, 1904, from a point five-eighths of a mile above the mouth to the milldam at Tuckerton, and with \$12,000 appropriated in 1905 the channel was dredged to the project widths from the mouth of the river to a point 2,100 feet below the milldam at Tuckerton, the depth made being 6 feet at mean low water, except the upper 581 feet, which was dredged to 5 feet at mean low water. This completed about one-half of the project.

No work has been done on the improvement during the past fiscal year.

The river and harbor act of March 2, 1907, appropriated \$12,000 for continuing the improvement and a project for its expenditure has been approved. This provides for the completion of the project in the upper part of the creek and the removal of some shoals below, and for dredging the cut at the mouth to deep water at the head of Marchelder channel. The work, however, is suspended on account of certain oyster beds which lie in the path of the proposed channel. It is understood that the leases given by authorities of the State of New Jersey will expire in August of this year. With this obstacle removed, it is probable that the work on the channel will be under way in the course of a few months.

The amount expended on this improvement to June 30, 1907, was \$23,757.77, of which \$2,006 was for maintenance. About one-half of project has been completed.

The maximum draft that could be carried on June 30, 1907, at mean low water over the shoalest part of the improvement was  $2\frac{1}{2}$  feet over the flats at the mouth, 5 feet thence to West Tuckerton Landing, and  $2\frac{1}{2}$  feet thence to the milldam.

The commerce reported for the calendar year 1906 is 3,230 tons, valued at \$917,585.

The improvement of Tuckerton Creek is not yet sufficiently advanced to show any material decrease in freight rates. Shipments from distant points have, however, been increased and facilitated, although lumber-laden vessels still are obliged to await tides at the flats at the mouth to enter the creek.

As the project progresses it is believed that cost of maintenance will decrease.

July 1, 1906, balance unexpended.....	\$248. 23
Amount appropriated by river and harbor act approved March 2, 1907..	12, 000. 00
	<hr/> 12, 248. 23
June 30, 1907, amount expended during fiscal year, for maintenance of improvement .....	6. 00
	<hr/> 12, 242. 23
July 1, 1907, balance unexpended.....	12, 242. 23
Amount (estimated) required for completion of existing project.....	27, 380. 00
(See Appendix I 8.)	

9. *Cold Spring Inlet, New Jersey.*—This is a new work. The locality is on the coast of New Jersey, about 3 miles east of the city of Cape May. Within the inlet there was originally a natural basin about 6 feet deep and 60 acres in area. In the throat of the inlet the depth was 29 feet at mean low water, and on the outside bar there was a minimum depth of 35 feet at low water about one-half mile out. There was no commerce.

Improvement of the locality was begun by private parties to enlarge the basin inside the inlet to about 500 acres in area, with a depth of 30 to 40 feet; and to complete the plan for a safe land-locked harbor for commerce and refuge, the General Government has undertaken to provide a suitable connection between it and the deep water in the ocean, so as to make the harbor accessible to seagoing vessels.

The plan of improvement adopted by the river and harbor act of March 2, 1907, contemplates providing an entrance channel 25 feet deep at mean low water, by construction of parallel jetties 750 feet apart and dredging between them, at an estimated cost of \$1,311,700. The adoption of this project was conditional upon the contribution of \$100,000 toward the improvement by local authorities or private parties, which contribution has been pledged.

Continuing contracts for completing the work were authorized in the sum of \$900,000, which is yet to be appropriated.

The said act also provided:

That no portion of the funds herein appropriated and authorized shall be expended until the necessary land and right of way for the shore ends of the jetties, for light-houses, for the establishment of a life-saving station, and for a depot of engineer supplies, shall have been deeded to the United States free of cost, and until assurance, satisfactory to the Secretary of War, shall have been given that the plan of the harbor, to be established by private capital inside the entrance, will be modified by increasing the distance between the

bulkheads immediately inside the shore end of the jetties in the manner recommended in said House Document Numbered Three hundred and eighty-eight, Fifty-ninth Congress, second session, and that the work proposed by the United States for the entrance channel to this harbor will be supplemented by such expenditure from private or corporate sources as shall make the harbor suitable for commerce and protected from injurious wave action: *And provided further*, That the Secretary of War shall have power to prescribe, regulate, and at any time modify the wharfage charges at this harbor, and no part of this appropriation shall be expended until the Cape May Real Estate Company shall, for itself and its successors and assigns, execute such formal acceptance of this proviso as the Secretary of War may require.

The report of survey upon which the plan of improvement is based is printed in House Document No. 388, Fifty-ninth Congress, second session.

Arrangements are in progress for carrying out the provisions of this act, the Cape May Real Estate Company having signified its agreement to at once execute a penal bond binding it to contribute the sum of \$100,000 to the improvement, and it is proposed to begin work by the Government toward jetty construction and dredging to a depth of 25 feet at mean low water at the inlet as soon as the preliminary provisions of the law have been complied with and duly approved. This may be consummated soon.

The amount estimated below as required for the completion of the project, and which amount is recommended for appropriation, is the balance provided for in the act for the completion of the project, in addition to the \$100,000 to be contributed by the Cape May Real Estate Company.

Amount appropriated by river and harbor act approved March 2, 1907	\$311, 000. 00
July 1, 1907, balance unexpended	311, 000. 00
Amount (estimated) required for completion of existing project	900, 000. 00

{	Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907	900, 000. 00
	Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

(See Appendix I 9.)

10. *Wilmington Harbor, Delaware.*—The harbor of Wilmington, Del., is in the Christiana River and includes a length of about 4 miles above its mouth at the Delaware River. It also includes the navigable portion of the Brandywine River, which flows into the Christiana River at a point about  $1\frac{3}{4}$  miles above its mouth.

Previous to 1836, when the first appropriation for the improvement of the Christiana River was made, the low-water depth at the entrance to this stream was about  $8\frac{1}{2}$  feet. The minimum depth in the channel in the portion of the river below Third Street Bridge, Wilmington, was 8 feet. This depth was increased in 1836 by dredging to 10 feet below low water, and under projects of 1871 and 1881 to 12 and 15 feet, respectively.

The present project is based upon a survey made in 1895 and adopted in river and harbor act of June 3, 1896. It provides for the formation, by dredging, rock removal, and construction of dikes, of a channel in the Christiana River 21 feet deep at mean low water from that depth in the Delaware River to the pulp works, a distance of about 4 miles, and thence diminishing to a depth of 10 feet at mean low water to the draw pier of the Philadelphia, Baltimore and

Washington Railroad cut-off bridge No. 4, the width at bottom varying between 250 feet at the mouth and 200 feet at bridge No. 4. The project further provides for the removal of shoals from bridge No. 4 to Newport to a depth of 7 feet at mean low water. This project was completed in 1906. The depth made over the rock ledges just above and below the Third Street Bridge is about 21½ feet.

At the close of the fiscal year 1906 dredging was in progress by the Government for the expenditure of the \$50,000 appropriated by the river and harbor act of March 3, 1905. This was continued to October 6, 1906. The channel was dredged to a depth of 18 feet at mean low water from the Delaware River to the Third Street Bridge, the widths made being 250 feet to the mouth of the Brandywine and thence 200 feet. The Third Street Bridge was the limit to which dredging could be done by the Federal Government under the terms of the appropriation, which was for work "up to Third Street Bridge."

To provide for the necessities of navigation above the Third Street Bridge, a very important part of the stream, the city of Wilmington appropriated \$4,857 in accordance with an act of the State legislature approved March 9, 1901, and with this appropriation the channel was dredged to a depth of 17 feet at mean low water and a width of 75 feet from a point about 1,100 feet above the Third Street Bridge to a point about 100 feet below the Market Street Bridge, resulting in a continuous channel 75 feet wide and 17 feet deep at mean low water from the Third Street Bridge to the Market Street Bridge and connecting with the channel above and below these bridges. This work was done under the supervision of the local United States engineer officer.

The condition of the channel on June 30, 1907, was approximately as follows:

The present channel has a depth of about 14 feet over shoals between the mouth and the Third Street Bridge; thence to Market street from 10 to 17 feet with a width of about 150 feet; above Market street to the Harlan and Hollingsworth shipyards a depth of about 12 feet with a width of about 100 feet; thence to the pulp works a depth of 9 feet with varying widths; and thence to Newport about 6 feet and a width of about 100 feet. The maximum draft that can be carried over the shoalest part of the river between the Delaware River and the pulp works is 9 feet.

The river and harbor act of March 2, 1907, appropriated \$75,000 for continuing the improvement and for maintenance, and contract has been entered into for dredging the channel to a depth of 18 feet at mean low water from the Delaware River to the mouth of the Brandywine, with a width of 250 feet, and 200 feet wide and 18 feet deep thence to the Baltimore and Ohio Railroad bridge. At the close of the fiscal year work had been begun upon the banks to retain the dredged material.

The amount expended on this improvement from 1836 to June 30, 1907, is \$919,506.50. Of this amount \$517,385.29 was expended on the present project, of which \$73,733.66 was for maintenance. This included the expenses of a survey and preparation of maps, etc., in connection with the establishment of harbor lines at the harbor of Wilmington, Del., which work has now been completed. .

The tonnage and value of the leading articles shipped to and from the port of Wilmington in the calendar year 1906 is reported to have been 1,016,696 tons, valued at \$64,511,617, which is approximately \$5,700,000 more than 1905 and \$33,000,000 more than any previous year.

The shipbuilding industry on the river is quite extensive, the records of the Department of Commerce and Labor showing that, with the exception of Philadelphia and Newport News, Wilmington had the largest steel-ship building output on the Atlantic coast for the ten years ending June 30, 1905.

The harbor improvements do not directly affect freight rates on light-draft boats to any large extent. Shipments thereon made by water range about 25 per cent lower in rate than by rail, but much more in deep-draft vessels, of which there are many, covering shipments to and from the manufacturers and shipbuilding plants.

As the present project has been completed, further expenditures on the harbor will be for maintenance. The experience of recent years has shown that about \$30,000 per annum is needed to maintain the channel at a depth of 18 feet on project widths. To maintain the project depth of 21 feet would require about \$60,000 per annum.

July 1, 1906, balance unexpended.....	\$33,560.42
Amount appropriated by river and harbor act approved March 2, 1907.....	75,000.00
Allotted from emergency appropriation river and harbor act of March 3, 1905.....	250.00
	<hr/>
	108,810.42
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	\$24,816.14
Returned to Treasury .....	62.97
	<hr/>
	24,879.11
July 1, 1907, balance unexpended .....	83,931.31
July 1, 1907, outstanding liabilities.....	8,000.00
	<hr/>
July 1, 1907, balance available .....	75,931.31
	<hr/>
July 1, 1907, amount covered by uncompleted contracts.....	55,000.00

(See Appendix I 10.)

11. *Appoquinimink, Murderkill, and Mispillion rivers, Delaware—*  
(a) *Appoquinimink River.*—At the time of the adoption of the present project there was a mean low-water depth of 2 feet at the entrance into Delaware Bay, and the shoalest depth inside the river was 4½ feet. The most serious obstructions to the navigation of the river were the many bends in the lower and middle sections.

The approved project is based upon a survey made in 1889, and adopted by Congress in river and harbor act of September 19, 1890. It provides for a channel 8 feet deep at mean low water, having a width of 80 feet from the bridge at Odessa, the head of navigation, to New bridge, near Townsend's wharf, a distance of 3¼ miles, and a width of 100 feet from this wharf to the mouth of the river, a distance of 5 miles. The estimated cost of the improvement is \$39,963.

A history of the work done up to June 30, 1905, may be found in the Annual Report of the Chief of Engineers for 1905, pages 175-176.

With \$5,500 allotted by the Secretary of War in 1905 from the appropriation made by the river and harbor act of March 3, 1905, for

improving Appoquinimink, Murderkill, and Mispillion rivers, a cut-off was made through the neck of land on the left bank of the river leading to Fennimore's (or New) bridge, about halfway between the mouth and Odessa. This cut-off shortens the channel distance by 2,272 feet, the distance between Odessa and the 7-foot contour in Delaware Bay being now about  $6\frac{3}{4}$  miles. At the conclusion of the operations there was a channel not less than 7 feet deep and not less than 50 feet wide from Odessa to the mouth, and the least depth across the Delaware Bay flats outside the mouth was  $\frac{1}{2}$  feet at mean low water.

No work was done on the improvement during the past fiscal year. The expenditures were for examinations and preliminary arrangements for dredging this year.

Under the provisions of the river and harbor act of March 2, 1907, the Secretary of War on March 20, 1907, approved an allotment of \$6,400 for expenditure on this improvement. Of this amount \$5,000 pertained to the act referred to and the remainder was funds available from former allotments. With these funds it is proposed to give the cut-off at Fennimore's bridge its full project widths of 80 feet above and 100 feet below the bridge, with a uniform depth of 7 feet at mean low water, and to redredge several shoals in the river that have formed in the channel dredged in 1904, and contract for this has been let in conjunction with dredging on other rivers, the entire work to be completed by November 11, 1907. Of this amount about \$3,000 will be applied under the approved project and the remainder for maintenance.

The amount expended on the improvement to June 30, 1907, is \$36,547.11, of which \$7,504.70 was for maintenance. About two-fifths of the work on the project remains to be done to complete it.

The maximum draft that could be carried on June 30, 1907, at mean low water, over the shoalest part was 6 feet in the river and 4 feet across the flats at the mouth.

The commerce of the river for the calendar year 1906 is reported to have been 32,370 tons, valued at \$2,180,375.

The freight rates, it has been reported, remain about the same, but the passenger business has increased in consequence of the improvement of the river.

July 1, 1906, balance unexpended.....	\$1,496.16
Amount allotted from appropriation made by river and harbor act approved March 2, 1907.....	5,000.00
Transferred from Mispillion River allotment.....	100.00
	<hr/>
	6,596.16

June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$150.00
For maintenance of improvement.....	396.36
	<hr/>
	546.36

July 1, 1907, balance unexpended.....	6,049.80
---------------------------------------	----------

July 1, 1907, amount covered by uncompleted contracts.....	4,200.00
Amount (estimated) required for completion of existing project.....	7,400.00

(b) *Murderkill River*.—This river is a tidal stream and a tributary of Delaware Bay and flows through Kent County, Del. Its navigable portion is about 9 miles long. The condition of the river was fair for

the greater part of its length, the average width and depth being 90 and 6 feet, respectively. Outside the junction with Delaware Bay, however, there was a serious obstruction—the flats, which are nearly bare at low tide and extend for nearly a mile from the shore. The average rise and fall of the tide at the mouth is 4.6 feet.

In 1881 an examination of this river was made and a project submitted for its improvement. No appropriation was made by Congress, however, as the river was at that time in the hands of an improvement and navigation company chartered by the State. This company had expended about \$10,000 in rectifying the many bends of the river by cutting straight canals and in dredging a narrow cut across the flats at the mouth. The latter slowly filled up again.

Under the provisions of the river and harbor act of September 19, 1890, a survey was made and report thereon is printed in House Executive Document No. 21, Fifty-second Congress, first session.

The project for improvement, which was adopted in the river and harbor act of July 13, 1892, is for a 7-foot low-water channel 80 feet wide from the town of Frederica, at the head of navigation, to the mouth of the river, and 150 feet wide from the mouth across the flats outside to the 7-foot curve of depth in Delaware Bay, the cut at the mouth to be protected by forming an embankment of the dredged material on each side, the estimated cost being \$47,550.

Dredging for original work and for maintenance has been done at different times since 1893. A history of operations to June 30, 1905, will be found in the Annual Report of the Chief of Engineers for 1905, pages 177–178.

The river and harbor act of March 3, 1905, appropriated \$20,000 for the improvement and maintenance of Appoquinimink, Murderkill, and Mispillion rivers. Of this amount, \$5,500 was allotted by the Secretary of War to the Murderkill River, and during July and August of that year these funds were applied to the dredging of 15 shoals in the river and the channel at the mouth and across the flats, resulting in an unobstructed channel 7 feet deep at mean low water and at least 50 feet wide from the steamboat wharf at Frederica to the 7-foot curve in Delaware Bay, a distance of about 8.4 miles.

The Secretary of War, under date of April 3, 1906, allotted the sum of \$3,860 from the appropriation for emergencies in river and harbor works made by the river and harbor act of March 3, 1905. With the funds thus provided the channel was dredged across the flats at the mouth and through Long reach, a distance of 1,800 feet in the river, resulting in a channel not less than 6 feet deep at mean low water and 50 feet wide from Frederica to Delaware Bay. This left about three-fifths of the work to be done on the project to complete it.

The river and harbor act of March 2, 1907, appropriated \$53,000 for improving the Appoquinimink, Murderkill, and Mispillion rivers, Delaware. Of this the Secretary of War has approved an allotment of \$8,000 for the Murderkill River, and this is to be applied in redredging the cut across the flats at the mouth to a width of 50 feet and a mean low-water depth of 6 feet, and in rectifying, widening, and dredging the channel in the river where needed, to a depth of 6 feet at mean low water. Contract for this has been made in conjunction with other dredging, the entire work to be completed by November 11, 1907. This work is for maintenance only.

No work has been done on the improvement during the past fiscal year. The expenditures were for examinations and preparations for this year's dredging.

The amount expended on this improvement to June 30, 1907, is \$40,174.57, of which \$16,813.79 was for maintenance.

The maximum draft that could be carried on June 30, 1907, at mean low water, over the shoalest part of the river is 5 feet from Frederica to the mouth, and 4 feet across the flats to Delaware Bay.

The commerce of the river, which is quite varied, is reported for the calendar year 1906 as 29,015 tons, valued at \$1,418,525, a large increase over the previous year's valuations, but slightly less in tonnage.

As to the effect of the improvement of this stream upon freight rates, it is reported that shipments by water are 25 to 50 per cent lower than by rail, and that in winter, when the boats can not run, the railroad increases its rates.

July 1, 1906, balance unexpended.....	\$565. 47
Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	8, 000. 00
	<hr/> 8, 565. 47
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	\$448. 37
Redeposited to credit appropriation for emergencies, river and harbor works.....	279. 19
	<hr/> 727. 56

July 1, 1907, balance unexpended.....	7, 837. 91
---------------------------------------	------------

July 1, 1907, amount covered by uncompleted contracts.....	7, 200. 00
Amount (estimated) required for completion of existing project.....	23, 264. 00

(c) *Mispillion River*.—This river is a tidal stream which enters Delaware Bay about 17 miles northwest of Cape Henlopen. It is navigable for about 12 miles. The mouth of the river was greatly obstructed by a flat foreshore without a channel. Vessels could enter and depart only at high water, the tidal range being about 4 feet.

The river from Milford, the head of navigation, to the mouth was improved by the General Government between the years 1879 and 1889, and \$17,000 was expended in making a channel 40 feet wide and 6 feet deep at mean low water.

The project for the improvement of the mouth of the river, proposed in a report on a survey made in 1891 and adopted in river and harbor act of July 13, 1892, provides for a cut across the flats in a southeasterly direction, having a width of 150 feet and a depth of 6 feet at mean low water, beginning opposite the light-house and ending in deep water in the bay, the cut to be protected on the upper or north side by a bank made of the excavated material. The estimated cost was \$24,000. A history of operations under this project from its adoption until June 30, 1905, will be found in the Annual Report of the Chief of Engineers for 1905, pages 179-180.

The river and harbor act of March 3, 1905, appropriated \$20,000 for improving Appoquinimink, Murderkill, and Mispillion rivers, Delaware, and of this appropriation \$9,000 was allotted for maintenance of this improvement. With these funds the channel was dredged between September, 1905, and March, 1906, to a depth of 4



feet at mean low water and a width of 30 feet for a distance of about 2 miles downstream from Milford, and across the bar at the mouth to a depth of 5 feet at mean low water and a width of 40 feet in a course southeast from the light-house toward the 5-foot curve in Delaware Bay, substantially along the line dredged in 1904; and the Green Point jetty, built in 1889, was repaired and extended for the protection of the dredged cut.

In 1906 the sum of \$10,000 was allotted by the Secretary of War from the appropriation for emergencies in river and harbor works in river and harbor act of March 3, 1905, to be applied to the maintenance of the improvement, in dredging the channel from Milford to Delaware Bay, the funds remaining over to be used, as far as they would go, to the extension of the south jetty for the protection of the channel, and to the close of the fiscal year 1906 the channel at the mouth had been dredged from the end of the north jetty outward toward deep water in Delaware Bay for a length of 2,420 feet. In July this cut was completed to the 5-foot curve in Delaware Bay, making a continuous channel 50 feet wide, 5 feet deep at mean low water, and 4,360 feet long. The channel in the river was then dredged at several points to give a width of 40 feet and a depth of  $4\frac{1}{2}$  feet at mean low water.

Work on the jetty was begun on September 1 and continued to November 16, 1906, during which period the Green Point jetty, on the southwest side of the channel, was extended for a length of 511.2 feet in a southeasterly direction, parallel to the north jetty.

The river and harbor act of March 2, 1907, provides as follows:

Improving Appoquinimink, Murderkill, and Mispillion rivers, Delaware: Continuing improvement and for maintenance, fifty-three thousand dollars, of which forty thousand dollars may be expended upon the Mispillion River in accordance with the report submitted in House Document Numbered One hundred and two, Fifty-sixth Congress, second session.

The report referred to submits a project for the improvement of the Mispillion by dredging the channel 6 feet deep at mean low water and 60 feet wide, increasing to 75 feet at sharp turns, from Milford to the mouth, and thence 4 feet deep and 150 feet wide across the flats, and the construction of a jetty along the south side of the channel, at an estimated cost of \$87,065.

Under date of March 20, 1907, the Secretary of War approved an allotment of \$40,000 for this improvement from the appropriation made by act quoted above, and contract has been entered into for such of the jetty work as can be done with the available funds, and work thereon is now in progress. The dredging is to be done later.

The amount expended to June 30, 1907, is \$78,816.63. Of this amount \$78,390.07 was on former projects, \$37,396.46 thereof being for maintenance. The amount expended to date on the present project is \$426.56.

The commerce of the river for the calendar year 1906 is reported to have been 258,704 tons, valued at \$6,117,323.

The effect of the improvement on freight rates is stated to be quite marked, a reduction of an average of 25 per cent being reported, in addition to affording better and increased transportation facilities.

The maximum draft that could be carried on June 30, 1907, at

mean low water over the shoalest part was 4 feet in the river and 2 feet across the flats at the mouth.

The project widths of channel can not be secured, but it is deemed of advantage to study the effect of the south jetty on the existing channel.

July 1, 1906, balance unexpended.....	\$10,170.72
Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	40,000.00
	<hr/> 50,170.72
Transferred to Appoquinimink River improvement.....	100.00
	<hr/> 50,070.72
June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$426.56
For maintenance of improvement.....	10,070.72
	<hr/> 10,497.28
July 1, 1907, balance unexpended.....	39,573.44
July 1, 1907, outstanding liabilities.....	150.00
	<hr/> 39,423.44
July 1, 1907, balance available.....	<hr/> 39,423.44
July 1, 1907, amount covered by uncompleted contracts.....	24,850.00
Amount (estimated) required for completion of existing project....	47,065.00

## CONSOLIDATED.

July 1, 1906, balance unexpended.....	\$12,232.35
Amount appropriated by river and harbor act approved March 2, 1907..	53,000.00
	<hr/> 65,232.35
June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$576.56
For maintenance of improvement.....	10,915.45
Returned to Treasury.....	279.19
	<hr/> 11,771.20
July 1, 1907, balance unexpended.....	53,461.15
July 1, 1907, outstanding liabilities.....	150.00
	<hr/> 53,311.15
July 1, 1907, balance available.....	<hr/> 53,311.15
July 1, 1907, amount covered by uncompleted contracts.....	36,250.00
Amount (estimated) required for completion of existing project....	77,729.00

(See Appendix I 11.)

12. *St. Jones River, Delaware.*—Before the channel was improved the least practicable low-water depth of water to Lebanon, 12 miles above the mouth, was 4 feet, and thence to Dover, 9 miles farther up the river, only  $2\frac{1}{2}$  feet.

The original project, made in 1880, was for a 3-foot low-water channel, 100 feet wide across the bar at the mouth, protected by a jetty, at an estimated cost of \$35,000. The project was modified in 1884 so as to include the removal of shoals in the river to a depth of 6 feet at mean low water. Improvements were not begun until 1885. The proposed channel within the river was reported as nearly completed at the close of the fiscal year ending June 30, 1888, \$25,000 having been expended.

A modification of the project for the improvement of the entrance was submitted and approved in March, 1889. This modified project provided for a cut across the bar at the mouth from the 6-foot depth inside the river to the corresponding depth outside the bar, the width of the cut to be 100 feet, of which 50 feet in the center was to be dredged to a depth of 6 feet, the remainder to a depth of 3 feet below mean low water. The material was to be deposited on either side of the cut to form training dikes, the outer ends of the dikes to be strengthened with pile revetments. It also provided for a new cut-off across a very sinuous bend in the upper river about 1 mile below Lebanon, near Wharton's fishery.

With funds provided by general and emergency river and harbor acts, dredging has been done at various times between 1889 and June 30, 1905. A history of these operations will be found in the Annual Report of the Chief of Engineers for 1905, pages 181-182.

Under date of March 9, 1906, the Secretary of War allotted the sum of \$9,500 from the emergency appropriation contained in the river and harbor act of March 3, 1905, for the restoration of the channel, and with this allotment, between May and September, 1906, the river was dredged from Lebanon downstream, where needed, to the mouth, the width made being 40 feet and the depth 7 feet, which included an allowance of 1 foot for overdepth allowed by the contract. At the mouth the channel was dredged across the flats to deep water in the bay to a width of 50 feet and depth of 7 feet at mean low water, which also included an allowance of 1 foot for overdepth under the contract.

The river and harbor act of March 2, 1907, appropriated \$3,000 for maintenance of this improvement, and this is to be expended in restoration of the channel across the flats at the mouth and such dredging as can be done with the remainder of the available funds in redredging the river. Work was begun on June 25, 1907, and to the close of the fiscal year the channel had been dredged a length of 250 feet in the river and 900 feet across the flats at the mouth, the depth made being 6 feet at mean low water and the width 50 feet.

The amount expended on this improvement to June 30, 1907, is \$57,808.49, of which \$16,308.49 was for maintenance.

The maximum draft that could be carried on June 30, 1907, at mean low water over the shoalest part, from Lebanon to the mouth, was 5 feet, and across the flats 4 feet.

The commerce of the river for the calendar year 1906 is reported to have been 55,196 tons, valued at \$6,165,940. That reported in 1900 was 69,241 tons, valued at \$3,569,829. It is stated that the improvements made have reduced freight rates by one-fourth to one-half, besides increasing shipments, especially fruits, which now reach the market in less time and fresher condition.

The river and harbor act of March 2, 1907, in addition to the appropriation for maintenance of the channel heretofore made, provided for a survey of the river between the mouth and Dover. Report upon this will be submitted in due course.

July 1, 1906, balance unexpended.....	\$8, 583. 47
Amount appropriated by river and harbor act approved March 2, 1907 .....	3, 000. 00
	<hr/> 11, 583. 47
June 30, 1907, amount expended during fiscal year:	
For maintenance of improvement.....	\$7, 800. 22
Returned to Treasury.....	1, 035. 24
	<hr/> 8, 835. 46
July 1, 1907, balance unexpended.....	2, 748. 01
July 1, 1907, outstanding liabilities.....	320. 00
	<hr/> 2, 428. 01
July 1, 1907, balance available.....	2, 428. 01
July 1, 1907, amount covered by uncompleted contracts.....	2, 300. 00

• (See Appendix I 12.)

13. *Smyrna River, Delaware.*—This river was formerly known as Duck Creek. It is a tidal stream flowing easterly into the Delaware River at a point about 26 miles south of Wilmington, Del. The navigable portion of the river was originally about 9 miles long; the minimum mean low-water depth over shoal places was 2½ feet in the river and 4 feet at the bar where it enters the Delaware River. The mean range of tide at the mouth is nearly 6 feet.

In 1878 a project was made for the improvement of the whole river, including the channel across the bar at the mouth. By direction of Congress the improvement of the bar was commenced first, and during the following four years three appropriations, aggregating \$10,000, were expended in dredging a channel 100 feet wide and 8 feet deep at mean low water across the bar. The dredged channel soon filled up again.

A new project was adopted in the river and harbor act of August 11, 1888, with a view of obtaining a channel of 7 feet depth throughout, width of 60 feet in the river and 100 feet at the bar, the channel over the bar to be protected by a stone jetty. The estimated cost of the improvement was \$90,698.20. Of this, \$37,365.20 was for dredging and \$53,333.20 for the jetty. This act made the first appropriation for work on the project and was by its terms to be applied to dredging only. The subsequent appropriations for continuing the improvement have also been applied to dredging.

The entire length of channel was dredged in parts at various times between 1888 and 1900 to the approved dimensions, except at the mouth of the river.

Under an allotment made in 1904 from the appropriation for emergencies in the river and harbor act of June 13, 1902, the channel was dredged in 1904 to a width of 50 feet and a depth of 6 feet at mean low water from the 6-foot curve just inside the mouth of Smyrna River across the flats to the 6-foot curve in Delaware Bay.

With an appropriation of \$15,000 made by the river and harbor act of June 13, 1902, as modified by the act of March 3, 1905, two cut-offs were made in 1905 extending from just below Limekiln wharf to the turn just above Mill Creek and from the mouth of Mill Creek to the bend above Brick Store wharf, an aggregate length of 4,795 feet. Some shoals in the river also were dredged, resulting in a channel 7 feet deep at mean low water from Smyrna Landing to

the 7-foot curve in Delaware Bay, the widths made being 60 feet through the cut-offs, not less than 50 feet in the river and 100 feet across the flats at the mouth. This work at the mouth completed the dredging required under the original project.

In May and June, 1906, five shoals in the river were removed with an allotment made by the Secretary of War under date of April 19, 1906.

The river and harbor act of March 2, 1907, appropriated \$2,000 for maintenance of this improvement. Work under a contract for the expenditure of this appropriation was begun on June 10 and continued to June 27, 1907. The result of the operations is a channel not less than 50 feet wide nor less than 6 feet deep from Smyrna Landing to the 6-foot curve in Delaware Bay, except in Cherry Tree reach, about halfway between Smyrna Landing and the mouth, where the depth is only 5 feet.

The maximum draft that could be carried on June 30, 1907, at mean low water over the shoalest part of the river was 5 feet and across the flats at the mouth 6 feet.

The amount expended on this improvement to June 30, 1907, is \$66,831.10. Of this amount \$56,831.10 is on the present project, of which \$11,746.32 was for maintenance.

The commerce for the calendar year 1906 is reported to have been 207,021 tons, valued at \$5,122,450.

The effect of the improvement of this river on freight rates has been to reduce them by about 25 per cent, and in addition it has resulted in the saving of time in shipments to Philadelphia and elsewhere. These conditions have stimulated certain industries, especially the fruit culture, and largely increased the production in this section.

The act of March 2, 1907, also authorized a survey to be made of Smyrna River, and a report upon this will be submitted in due course.

Experience has just shown that the last appropriation, \$2,000, is not sufficient to remove the annual shoaling.

July 1, 1906, balance unexpended-----	\$2,238.44
Amount appropriated by river and harbor act approved March 2, 1907-----	2,000.00
	<hr/> 4,238.44
June 30, 1907, amount expended during fiscal year, for maintenance of improvement-----	\$1,676.12
Returned to Treasury-----	585.79
	<hr/> 2,261.91
July 1, 1907, balance unexpended-----	1,976.53
July 1, 1907, outstanding liabilities-----	1,785.00
	<hr/>
July 1, 1907, balance available-----	191.53
(See Appendix I 13.)	

14. *Broadkill River, Delaware.*—In its original condition the depth of water in the river was from 3 to 4 feet at the numerous shoals which impeded navigation. The depth at the mouth was from 1½ to 2 feet at low water.

Prior to the adoption of the existing project \$35,000 was expended in providing a channel within the river 6 feet deep and 40 feet wide at low water from the mouth to Milton, the head of navigation.

The existing project was adopted by the river and harbor act of March 2, 1907, and contemplates the establishment of a permanent entrance at the mouth of the river by dredging a channel from the 6-foot curve in Delaware Bay to the same depth in the river and constructing a jetty on the north side of this channel. A small gap is to be left in the jetty for use by vessels and to permit circulation. The estimated cost of this project is \$33,330.

The range of tide is 4.1 feet at the mouth, 3.6 feet at the draw-bridge, and 3.4 feet at Milton, and the available depth not over 4½ feet in the river and from 2 to 3 feet at the mouth.

No work has yet been done to carry out this project, beyond making preliminary arrangements for it, on account of delay in securing approval of title to certain land required for a cut to be made across Lewes Cape. As soon as this is secured, and it is expected shortly, work will be commenced.

The water traffic this year between Milton and points in Delaware and Pennsylvania is reported to be valued at \$1,085,000. The water rates are about two-thirds of those by rail. These rates are not expected to be lowered by the improvement of the stream, but better service will make them of more value to the community and increase the stated value of freight by at least 150 per cent.

The amount expended to June 30, 1907, is \$75.54.

The report of survey on which the present project is based is printed in House Document No. 214, Fifty-ninth Congress, second session.

Amount appropriated by river and harbor act approved March 2, 1907.	\$33,330.00
June 30, 1907, amount expended during fiscal year, for works of improvement	75.54

July 1, 1907, balance unexpended	33,254.46
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(See Appendix I 14.)

15. *Removing sunken vessels or craft obstructing or endangering navigation.*—During the past fiscal year wrecks were examined as follows:

Steamer *Ranald* sunk in Atlantic Ocean, off Atlantic City, N. J.

Barge *Baker* sunk in the Atlantic Ocean, off Atlantic City, N. J.

The expenditures during the year amounted to \$100.68.

(See Appendix I 15.)

#### EXAMINATIONS AND SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF MARCH 3, 1905.

Reports on preliminary examinations and surveys required by the river and harbor act of March 3, 1905, of the following localities within this district were duly submitted by the district officer. They were reviewed by the Board of Engineers for Rivers and Harbors, pursuant to law, and were transmitted to Congress and printed in documents, as indicated.

1. *Preliminary examination and survey of Cold Spring Inlet, Cape May, N. J., with a view to securing a channel from the existing harbor to deep water and the creation of a harbor of refuge.*—Reports dated August 14, 1905, and December 15, 1906, are printed in House Docu-

ment No. 388, Fifty-ninth Congress, second session. Various plans for improvement are presented, estimated to cost from \$895,800 to \$1,311,000, in round numbers.

2. *Preliminary examination and survey of Broadkill Creek, or River, Delaware.*—Reports dated June 6, 1905, and March 29, 1906, are printed in House Document No. 214, Fifty-ninth Congress, second session. A plan is presented for improvement at an estimated cost of \$33,330.

3. *Preliminary examination and survey of Indian River, Delaware.*—Reports dated December 12, 1905, and December 21, 1906, are printed in House Document No. 482, Fifty-ninth Congress, second session. Improvement of this locality by the United States is not deemed advisable.

IMPROVEMENT OF PATAPSCO RIVER AND BALTIMORE HARBOUR,  
MARYLAND; OF RIVERS AND HARBORS IN MARYLAND ON THE  
EASTERN SHORE OF CHESAPEAKE BAY; OF NANTICOKE RIVER,  
MARYLAND AND DELAWARE, AND OF BROAD CREEK RIVER, DELA-  
WARE.

This district was in the charge of Col. R. L. Hoxie, Corps of Engineers. Division engineer, Col. Amos Stickney, Corps of Engineers, until June 4, 1907, and Col. D. W. Lockwood, Corps of Engineers, since that date.

1. *Patapsco River and channel to Baltimore, Md.*—Before operations were begun by the United States a controlling depth of 17 feet was available, with a mean range of tide of a little over 1 foot. Vessels over that draft were obliged to lighter portions of their cargoes about 14 miles below to permit them to reach the wharves of the city. There were pockets where deeper water prevailed, but these were unconnected by any channel, natural or artificial. Under the original project, dated April 15, 1853, for a channel 22 feet deep at mean low water and 150 feet wide, the Fort McHenry channel was dredged, extending from the limits of the city of Baltimore to a point just below Fort Carroll, and the Brewerton channel from this point to deep water of Chesapeake Bay off Swan Point. The cost was \$390,000.

In 1871 the project was enlarged to a width of 400 feet at the lower end of the channel, diminishing to 250 feet at its upper end, with a mean low-water depth of 24 feet. Meantime it had been found that the portion of the Brewerton channel, which was swept across by the current of the Susquehanna River, was continually obstructed by sedimentary deposit. This led to a search for a better location for a deep channel which could be made and maintained by dredging and the natural currents. This was found in the position of the resultant of the two great forces made by the currents of the Susquehanna and Patapsco rivers. The new channel had also the advantage of being shorter by several miles, and for this reason and the very much diminished sedimentary deposit the cost of maintenance was much lessened. In 1892 a project for 27 feet depth at mean low water, with a width of 600 feet in the straight sections and over 1,200 feet in the angles, was completed. At the same time the portion of the Brewerton channel between the upper end of the present cut-off and the point of intersection of the Brewerton and Craighill channels was

abandoned because of the sedimentary deposit from the Susquehanna sweeping across it and to shorten the channel still further and lessen the cost of maintenance. The projects of dredging to depths of 24 and 27 feet and the two changes in the position of the channel were designed and executed by Col. W. P. Craighill, Corps of Engineers. The act of June 3, 1896, authorized the increase of the depth of the channel to 30 feet at mean low water, with a bottom width of 600 feet, widened at the angles, and with side slopes of 3 base to 1 vertical. This was completed May 22, 1903, and has since been maintained. The amount expended on original and modified projects prior to operations under existing project is \$4,721,269.48, of which \$32,797.72 was for maintenance.

The existing project, adopted by Congress March 3, 1905, provides for a channel 35 feet deep at mean low water and 600 feet wide at bottom, with side slopes of 3 base to 1 vertical from Fort McHenry to deep water in Chesapeake Bay above Sandy Point light-house and through the shoals opposite York Spit, at an estimated cost of \$3,465,000. An appropriation of \$250,000 was made in the river and harbor act of March 3, 1905, and work was authorized under continuing contracts to an additional amount of \$1,000,000. Such contracts were entered into. Dredging began July 5, 1905, and resulted to date in a depth of 35 feet for a width of 300 feet in the section near Baltimore, and a varying depth of from 31 feet to 35 feet for a width of 300 feet in the section opposite York Spit, completing about two-fifths of the project. An appropriation of \$500,000 was made in the river and harbor act of March 2, 1907, and work was authorized under continuing contracts for completion to an additional amount of \$1,715,000, which is yet to be appropriated. Proposals for this work are to be opened July 1, 1907. With the funds available and to be provided for under continuing contracts it is proposed to complete the project.

The amount expended on the existing project to the close of the fiscal year ending June 30, 1907, is \$789,632.40.

The draft that can now be carried to Baltimore, the head of navigation, a distance of 11 miles from the mouth of Patapsco River and 171 miles from the mouth of Chesapeake Bay, is 31 feet at mean low water. The length of dredged channel in Patapsco River and Chesapeake Bay above Sandy Point is about 19 miles; opposite York Spit, about  $4\frac{1}{2}$  miles.

The tonnage movement of the port has been as follows:

Fiscal year ending June 30—	Tons.	Fiscal year ending June 30—	Tons.
1889 -----	3, 243, 017	1899 -----	6, 843, 620
1890 -----	4, 237, 361	1900 -----	7, 941, 580
1891 -----	4, 495, 469	1901 -----	8, 055, 017
1892 -----	5, 224, 042	1902 -----	7, 529, 870
1893 -----	4, 607, 176	1903 -----	7, 736, 447
1894 -----	4, 752, 946	1904 -----	7, 334, 241
1895 -----	4, 794, 964	1905 -----	7, 510, 713
1896 -----	5, 363, 894	1906 -----	8, 277, 098
1897 -----	6, 868, 120	1907 -----	8, 448, 203
1898 -----	7, 339, 405		



The statistics of the port for the past fiscal year are illustrated briefly by the following table:

Dutiable imports have increased.....	\$2, 778, 156. 00
Free imports have increased.....	\$1, 780, 623. 00
Domestic exports have decreased.....	\$5, 316, 578. 00
Tonnage (foreign) has increased.....tons.....	171, 105
Duties collected have increased.....	\$345, 373. 24
Duties on merchandise in bond have decreased.....	\$427. 60
Duties on merchandise in bond, with and without appraisement, have increased.....	\$363, 308. 45

The effect of the present project upon freight rates can not be ascertained until work is completed, but as some of the vessels trading with the port are not now able to load to their full capacity the tendency should be toward cheapening rates when means are provided to enable them to carry full cargoes and to enable other vessels of greater capacity to trade with the port.

References to reports of examinations and surveys are to be found on page 180 of the Annual Report of the Chief of Engineers for 1904.

July 1, 1906, balance unexpended.....	\$549, 552. 74
Amount appropriated by river and harbor act approved March 2, 1907.....	500, 000. 00
Amount appropriated by sundry civil act approved March 4, 1907.....	500, 000. 00
	<hr/> 1, 549, 552. 74
June 30, 1907, amount expended during fiscal year, for works of improvement.....	569, 424. 62
July 1, 1907, balance unexpended.....	980, 128. 12
July 1, 1907, outstanding liabilities.....	3, 242. 25
July 1, 1907, balance available.....	<hr/> 976, 885. 87
July 1, 1907, amount covered by uncompleted contracts.....	236, 451. 66
Amount (estimated) required for completion of existing project.....	<hr/> 1, 715, 000. 00

{	Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907.....	800, 000. 00
	Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

(See Appendix J 1.)

2. *Channel to Curtis Bay, in Patapsco River, Baltimore Harbor, Maryland.*—With a mean range of tide of a little over 1 foot, there was a controlling depth of 20 feet at mean low water in 1893, when the first improvement was undertaken by the United States. The original project was dated July 15, 1892, and was for a channel 27 feet deep at mean low water and a bottom width of 150 feet, at an estimated cost of \$85,000. Forty thousand dollars of the estimate was appropriated, and with this total expenditure the channel was first made 25 feet deep for the project width and then dredged to 27 feet depth for a width of 70 feet in the axis of the 150-foot channel. That project never was completed. It was superseded by a project in the river and harbor act approved June 13, 1902, for deepening the channel to 30 feet and widening it to 250 feet, and authority was granted to make continuing contracts to complete the work. The estimated cost was \$196,000.

A continuing contract was approved, and under it dredging was commenced March 5, 1903, and the project completed November 30,

1903. The amount expended on existing project to June 30, 1907, was \$192,683.36, no portion having been applied to maintenance. The balance available will be expended under a contract entered into for partial maintenance.

Curtis Bay is the mouth of Curtis Creek, which is navigable in fact  $5\frac{1}{2}$  miles above the head of the channel contemplated by the existing project, but a maximum draft of  $28\frac{1}{2}$  feet at mean low water can be carried June 30, 1907, over the shoalest part of the locality under improvement, which is a distance of  $21\frac{1}{2}$  miles.

It is stated that the improvement has lowered rates upon freight, but the amount of reduction has not been ascertained.

References to reports on examinations and surveys are to be found on page 180 of the Annual Report of the Chief of Engineers for 1904.

This bay is in the collection district of Baltimore and the statistics are attached to the report for that harbor.

July 1, 1906, balance unexpended.....	\$3, 549. 68
June 30, 1907, amount expended during fiscal year, for works of improvement .....	233. 04
July 1, 1907, balance unexpended.....	3, 316. 64
July 1, 1907, outstanding liabilities.....	34. 83
July 1, 1907, balance available .....	3, 281. 81
July 1, 1907, amount covered by uncompleted contracts.....	3, 149. 92

(See Appendix J 2.)

3. *Harbor of southwest Baltimore (Spring Garden), Md.*—No work was done by the United States before the existing project, but the city of Baltimore dredged a channel from the main ship channel to the foot of Eutaw street, which had a controlling depth of 15 feet at mean low water. The average rise of the tide is a little over 1 foot. In response to a resolution of the House of Representatives an estimate was furnished March 7, 1896 (printed in Annual Report for 1896, p. 1006), of the cost of deepening the channel to a depth of 27 feet. It was for a channel 100 feet wide on the bottom, with side slopes of 1 on 3, from the main ship channel near Fort McHenry to the foot of Eutaw street, with a turning basin 400 feet by 400 feet near the upper end, at an estimated cost of \$314,000, which is the existing project. Five thousand dollars was appropriated June 3, 1896, but it was deemed inexpedient to start the work with that small sum. June 13, 1902, \$88,000 was appropriated and authority granted to enter into contracts for the completion of the work. A continuing contract was made for the completion of the project, and it was completed April 4, 1905. The sum of \$314,000 has been expended to June 30, 1907.

An appropriation of \$6,500 was made for maintenance in the river and harbor act of March 2, 1907. This will be used in the partial removal of extensive shoals, under a contract entered into. This channel was dredged in very soft material, where silt has been slowly accumulating for many years. The cost of maintenance for a number of years will probably continue to be large, but after the side slopes have flattened out sufficiently it is thought that the cost of maintenance will be much reduced. The maximum draft that can be carried June 30, 1907, at mean low water over the shoalest part of the

locality under improvement is 25 feet at the lower end and about 18 feet at the upper end.

The stream is navigable in fact to Baltimore, Md., which is 14 miles from the mouth of Patapsco River and 174 miles from the mouth of Chesapeake Bay. The length of the channel dredged under the existing project is 4 miles. It is stated that the improvement has somewhat lowered freights, but the amount of reduction has not been ascertained.

The commercial statistics of the port of Baltimore include this harbor.

Amount appropriated by river and harbor act approved March 2, 1907. \$6,500.00

July 1, 1907, balance unexpended.....	6,500.00
July 1, 1907, outstanding liabilities.....	34.83

July 1, 1907, balance available .....	6,465.17
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July 1, 1907, amount covered by uncompleted contracts.....	5,850.08
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(See Appendix J 3.)

4. *Elk River, Maryland.*—Before improvements were commenced there was practically no navigation above Cedar Point. The original project, dated July 17, 1874, was for a channel 6 feet deep at low water, or 8 feet at high water, from Cedar Point to Elkton, the head of navigation, and in the Little Elk as far as Bennett's wharf. The mean range of the tide is 2 feet. Such a channel was estimated to cost \$36,000 if 75 feet wide and about \$25,000 if 50 feet wide, cheap dikes being required for regulating the banks and to provide a place behind which to deposit the material dredged from the shoals. The first work was done in 1874, when \$5,000 was expended in building a dike and dredging to a width of 25 feet and a depth of 6 feet at mean low water in front of it and for about 300 feet below. Two years later the channel was made 40 feet wide from the bridge at Elkton to about one-half mile below. In 1884 a channel was completed 80 feet wide through the bar near the mouth of the Little Elk River and 70 feet wide thence to the bridge at Elkton, the depth being 7 feet at mean low water. In 1893 a channel 100 feet wide and 8 feet deep from deep water below Cedar Point to the bridge at Elkton was completed. The expenditure on the original and subsequent projects has amounted to \$46,500.

The channel had shoaled, and in a report on a survey made in 1899 (printed on pp. 1668-1669, Pt. 2, Annual Report for 1900) it was proposed to restore the channel to 8 feet depth at mean low water and 100 feet wide from deep water below Cedar Point to the bridge at Elkton, at an estimated cost of \$16,665, with an annual cost of \$2,500 for maintenance. The river and harbor act of June 13, 1902, adopted this project, and appropriated \$16,665 for the work. This appropriation was practically expended in dredging in the fiscal year ending June 30, 1903. The project width of 100 feet could not be made, as the river was found to have shoaled very much since the survey in 1899, on which the appropriation was based. The act of March 3, 1905, appropriated \$2,000 for maintenance, and at the close of the fiscal year ending June 30, 1906, the work had been done. It consisted in dredging a 40-foot cut through the shoals which had formed between the fertilizer works and Cecils Ditch. The amount expended

on this improvement to June 30, 1907, is \$65,165.91, of which \$63,165 was on previous projects, and \$2,000 for maintenance.

The existing project, adopted by the river and harbor act of March 2, 1907, is for a channel 6 feet deep at mean low water and 100 feet wide from Elkton to Cedar Point, at an estimated cost of \$16,802.77. The act appropriated \$18,803 for its completion and maintenance. A contract has been entered into for the work.

The maximum draft that could be carried June 30, 1907, at mean low water over the shoalest part of the river was  $3\frac{1}{2}$  feet. The stream is navigable in fact to Elkton, Md., which is about 16 miles from the mouth of the river.

It is stated that the improvement has lowered freight rates, but the amount of reduction has not been ascertained.

Reference to a report on a survey is to be found on page 182 of the Annual Report of the Chief of Engineers for 1904. Reference to report on preliminary examination and survey of the river, required by the river and harbor act of March 3, 1905, will be found on page 214 of the Annual Report of the Chief of Engineers for 1906.

The commerce of the river for the calendar year 1906 is reported to be 15,179 tons, valued at \$198,605. Two steam tugs and 35 schooners and barges are reported as plying in the river.

Amount appropriated by river and harbor act approved March 2, 1907	\$18,803.00
June 30, 1907, amount expended during fiscal year, for works of improvement	.91
July 1, 1907, balance unexpended	18,802.09
July 1, 1907, outstanding liabilities	15.75
July 1, 1907, balance available	18,786.34
July 1, 1907, amount covered by uncompleted contracts	16,922.70

(See Appendix J 4.)

5. *Susquehanna River above and below Havre de Grace, Md.*—The original governing depth was 5 feet at mean low water. The mean range of tide is  $2\frac{1}{2}$  feet. The channel above Havre de Grace was narrow and subject to ice gorges. The original project is dated February 22, 1853, and was for a channel 12 feet deep and 100 feet wide, at an estimated cost of \$59,000. Improvements have been in progress since 1853, and up to August 22, 1882, when the existing project was adopted, \$97,390 had been expended upon them. The existing project is to give a channel 200 feet wide and 15 feet deep at mean low water below Havre de Grace, and to remove the shoal opposite Watson Island (which is above Havre de Grace) to a depth of 8 feet at the same stage of the tide, at an estimated cost of \$168,000. The amount expended on that project to June 30, 1907, is \$93,500 and has resulted in dredging a portion of the channel below Havre de Grace to a depth of 15 feet at mean low water and removing the shoal opposite Watson Island. Ten thousand dollars was appropriated by the act of March 3, 1905, and with this sum the channel was widened at a point about 4,000 feet below Havre de Grace, where operations were suspended in 1904, completing about one-half of the approved project. The river and harbor act of March 2, 1907, appropriated \$20,000, and a contract to continue dredging has been entered into.

The maximum draft that can be carried June 30, 1907, at mean low water over the shoalest part of the channel under improvement, is 11 feet. The stream is navigable in fact to Port Deposit, Md., which is about 5 miles above the mouth of the river. The improvement has made no appreciable difference in freight rates.

Three steamers and 80 sailing vessels and barges are reported as plying in the river, the commerce being valued at \$542,200. The tonnage of the river is reported to be as follows: 1905, 135,293; 1906, 73,815.

Amount appropriated by river and harbor act approved March 2, 1907. \$20,000.00

July 1, 1907, balance unexpended-----	20,000.00
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July 1, 1907, outstanding liabilities-----	20.15
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July 1, 1907, balance available -----	19,979.85
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July 1, 1907, amount covered by uncompleted contracts-----	18,000.00
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Amount (estimated) required for completion of existing project ----	54,500.00
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(See Appendix J 5.)

6. *Harbors at Rockhall, Queenstown, Claiborne, and Cambridge, and Chester, Choptank, Warwick, Pocomoke, La Trappe, and Manokin rivers, and Tyaskin Creek, Maryland.*—(a) *Rockhall Harbor and inner harbor at Rockhall.*—In 1894 the controlling depth at Rockhall Harbor was 5 feet, with an average range of tide of 1.1 feet. With an appropriation of \$16,000 made June 3, 1896 (the first for this work), a project was carried out in 1897–98 for dredging a cut 80 feet wide and 10 feet deep at mean low water from the 10-foot curve in Swan Creek Inlet to the 10-foot depth in Chesapeake Bay, and a channel 100 feet wide and 10 feet deep from that depth in Swan Creek Inlet to the old pier at Rockhall. A turning basin, embracing the old and new piers, was also dredged.

In accordance with the river and harbor act of March 3, 1899, an examination was made of Rockhall Harbor and the inner harbor at Rockhall, report on which is printed in the Annual Report for 1900, pages 1670–1672. The project then proposed is dredging a channel 12 feet deep and 150 feet wide from Chesapeake Bay to Swan Creek Inlet, across Swan Point bar, and 12 feet deep and 150 feet wide from Swan Creek Inlet to the wharf at Rockhall at an estimated cost, in 1899, of \$43,065, and \$9,208 every two years for maintenance.

The river and harbor act of June 13, 1902, adopted this project, which is the existing one, and appropriated \$74,000 for dredging certain harbors and rivers on the eastern shore of Chesapeake Bay, including Rockhall Harbor. The sum of \$12,000 was allotted for this improvement, the available sum to be applied to dredging a channel 12 feet deep and as wide as practicable within the project limits from Swan Creek Inlet to the wharf at Rockhall. Contract for dredging on this and the other improvements on the eastern shore of Chesapeake Bay was made, under which the entire work was to be completed by December 31, 1903. The contract was completed June 1, 1904. All the dredging was done in the inner harbor, with the result of establishing a 10-foot navigation there.

The river and harbor act of March 3, 1905, appropriated \$44,000 for dredging certain harbors and rivers on the east shore of Chesapeake Bay. The sum of \$12,829.35 was allotted for this improve-

ment, to be applied to the existing project. The work was put under contract and dredging was begun in the summer of 1905 and completed in the autumn, resulting in the completion of the channel of the inner harbor, except for a distance of 500 feet where the width is less than the project. The river and harbor act of March 2, 1907, appropriated \$60,000 for improvement of rivers and harbors on east shore of Chesapeake Bay, and \$14,383.97 was allotted for this work. A contract for expenditure of funds has been entered into.

The channel across Swan Point bar is practically obliterated, no funds being available for maintenance since the channel was originally dredged. It is questionable whether the channel at this point can be maintained at reasonable cost, and it may be necessary to abandon it and make a detour to the southward so as to avoid this bar. The unit price of dredging has exceeded that assumed in the original estimate. The estimated cost of project was increased May 13, 1907, to \$60,386.81.

The amount expended on this improvement to June 30, 1907, is \$41,436.01, of which \$16,597.12 was on a previous project and \$537.54 for maintenance, consisting in the removal of a shoal in the inner harbor.

About two-fifths of the project has been completed.

The maximum draft that could be carried June 30, 1907, at mean low water over the shoalest part of the channel across Swan Point bar is about 4 feet and in the inner harbor 12 feet, to which point the improvement is navigable in fact. The harbor is a bay making in from Chesapeake Bay and is navigable in fact to Rockhall pier, which is about one-fourth mile above the mouth of Rockhall Harbor.

In 1905 over 50 vessels of from 5 to 50 tons made this harbor their headquarters and steamers made a daily service from Baltimore, their course from Baltimore being down the bay and around the south end of Swan Point bar to the inner harbor at Rockhall.

It was impracticable to procure commercial statistics for 1906, those for 1905 being reported at \$388,811.

Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	\$14,383.97
June 30, 1907, amount expended during fiscal year, for works of improvement .....	6.66
July 1, 1907, balance unexpended.....	14,377.31
July 1, 1907, outstanding liabilities.....	6.95
July 1, 1907, balance available.....	14,370.36
July 1, 1907, amount covered by uncompleted contracts.....	12,945.58
Amount (estimated) required for completion of existing project.....	21,711.03

(b) *Queenstown Harbor*.—Before 1871 the controlling depth in this harbor was 6 feet, with a range of tide of about 2 feet. Between that year and 1880 it was improved under a project dated January 2, 1871, and a channel 100 feet wide at bottom and 8 feet deep at mean low water was made. In 1897, with \$5,000 appropriated for continuing the improvement, a channel was dredged to 8½ feet at mean low water and 100 feet wide from Chester River to the inner harbor, to which point the improvement is navigable in fact, and in 1900 a shoal extending from a point 138 feet above the lower light down for a dis-

tance of 950 feet was dredged to a depth of 8 feet and a width of 80 feet.

Of the \$74,000 appropriated by the river and harbor act of June 13, 1902, for dredging certain harbors and rivers on the eastern shore of Chesapeake Bay, the sum of \$12,000 was allotted to Queenstown Harbor. The act provides that the improvement shall be made in accordance with the report submitted and printed in the Annual Report of the Chief of Engineers for 1900, pages 1673-1676. The project therein submitted contemplates increasing the dimensions of the channel so as to make them 10 feet deep and 200 feet wide, at an estimated cost of \$23,100. With the allotment the entire length of channel was dredged under contract to a depth of 10 feet at mean low water and as wide as practicable within the project limits.

The river and harbor act of March 3, 1905, appropriated \$44,000 for improvement of harbors and rivers on the east shore of the Chesapeake Bay, and \$4,606.50 was allotted for this harbor, to be applied toward completing the project. A contract was made and work begun on it in the summer of 1905 and completed in the autumn, which resulted in widening and deepening the channel for a distance of about 1,200 feet. The river and harbor act of March 2, 1907, appropriated \$60,000 for improvement of rivers and harbors on east shore of Chesapeake Bay, and \$4,975.70 was allotted for this work. A contract for expenditure of funds has been entered into. Owing to insufficient appropriations, the work has been prolonged and the cost of maintenance is added to the original estimate. The unit price of dredging has exceeded that in the original estimate. The estimated cost of project was therefore increased May 13, 1907, to \$25,886.35.

The amount expended on this improvement to June 30, 1907, is \$35,606.50, of which \$16,606.50 was on the existing project. About three-fifths of the project has been completed. The maximum draft that could be carried June 30, 1907, at mean low water over the shoalest part of the locality under improvement was  $8\frac{1}{2}$  feet.

Six steamers and 175 sailing vessels and barges are reported to ply in the harbor. The tonnage of the harbor is reported to be as follows: 1900, 12,373; 1901, 11,328; 1902, 18,769; 1903 (only partial statistics could be obtained), 3,889; 1904, 19,144; 1905, 19,421; 1906, 19,808, valued at \$835,872.

The harbor is a bay making from the Chester River and is navigable in fact to Queenstown, which is about one-half mile above mouth of harbor. The improvement has made no perceptible difference in freight rates.

Amount allotted from appropriation by river and harbor act approved

March 2, 1907.....	\$4, 975. 70
July 1, 1907, balance unexpended.....	4, 975. 70
July 1, 1907, amount covered by uncompleted contracts.....	4, 478. 13
Amount (estimated) required for completion of existing project.....	4, 304. 15

(c) *Claiborne Harbor*.—Claiborne is on the eastern shore of Chesapeake Bay, about 6 miles east from Bloody Point light-house. No improvement there had ever been made by the United States previous to the existing project. The controlling depth was 9 feet at mean low water with a mean range of tide of about 2 feet. The sum of \$15,000 was allotted for this improvement from the \$74,000 appropriated by the river and harbor act of June 13, 1902, for certain harbors and rivers on the eastern shore of Chesapeake Bay, Maryland. The act

provides for dredging a channel 12 feet deep at mean low water and 300 feet wide from the 12-foot contour in Eastern Bay to the railroad pier in the harbor, a distance of about 1,900 feet, and thence shoreward along the south side of the pier to a width of 195 feet for a length of 500 feet, at an estimated cost of \$17,490, and a further sum of \$2,500 for an extension of the existing jetty, should it be found necessary. This is the existing project.

A 12-foot depth at mean low water was dredged with variable widths in the fiscal year ending June 30, 1904. The sum of \$44,000 was appropriated by the river and harbor act of March 3, 1905, for harbors and rivers on the east shore of the Chesapeake Bay, \$1,863.35 of which was allotted to this harbor, and a contract was made and dredging done in the autumn of 1905. The work was all for maintenance, and consisted in removing a shoal which had formed in the channel. The river and harbor act of March 2, 1907, appropriated \$60,000 for improvement of rivers and harbors on east shore of Chesapeake Bay, and \$3,440.24 was allotted for this work. A contract for expenditure of funds has been entered into. About three-fifths of the project has been completed. The maximum draft that could be carried June 30, 1907, at mean low water over the shoalest part of the channel is 11 feet. The amount expended to June 30, 1907, is \$16,863.35, of which \$1,863.35 was for maintenance. Owing to insufficient appropriations the work has been prolonged and the cost of maintenance is added to the original estimate. The unit price of dredging has exceeded that in the original estimate. The estimated cost of project was therefore increased May 13, 1907, to \$27,408.30.

Claiborne is at the head of navigation in Claiborne Harbor, and is the western terminus of the Baltimore, Chesapeake and Atlantic Railway. It is about one-half mile from the mouth of the harbor.

Three steamers and 70 sailing vessels and barges are reported to ply in the harbor.

The tonnage of the harbor is reported to be as follows: 1903, 89,549; 1904, 90,435; 1905, 93,603; 1906, 91,957, valued at \$3,461,714. The improvement has made no appreciable difference in freight rates. Reference to a survey is to be found on page 185 of the Annual Report of the Chief of Engineers for 1904.

Amount allotted from appropriation by river and harbor act approved

March 2, 1907.....	\$3, 440. 24
July 1, 1907, balance unexpended.....	3, 440. 24
July 1, 1907, amount covered by uncompleted contracts.....	3, 096. 22
Amount (estimated) required for completion of existing project.....	8, 968. 06

(d) *Cambridge Harbor*.—This harbor is on the eastern side of the Choptank River, about 20 miles above its mouth, and Cambridge is the head of navigation at the mouth of the harbor. In 1870, before operations were commenced, there was a controlling depth of 4 feet, with a mean range of tide of about 1.7 feet. The improvement of the harbor was commenced in 1871 with a project submitted in March of that year for an entrance way of 100 feet in width and to provide sufficient harbor accommodations of a depth of 10 feet at mean low water. The estimated cost was \$36,000. The sum of \$10,000 was appropriated March 3, 1871, and work begun. On this and succeeding projects \$50,237 was expended to June 30, 1896, resulting in a channel 150 feet wide and 12 feet deep at mean low water from that



depth in the Choptank River to the railroad wharf, a distance of nearly a mile. The inner harbor below the bridge had been dredged over its whole irregular area to a depth of 10 feet, and the part of the harbor above the bridge for a distance of 750 feet had been dredged to a depth of 8 feet and a width of 215 feet. A survey was made in 1896 (printed in Annual Report for 1897, p. 1297), and the improvements then recommended were for a 12-foot low-water channel 150 feet wide from the 12-foot curve in the Choptank River to a point 500 feet outside the Baltimore, Chesapeake and Atlantic Railway Company's steamboat wharf, and from this point gradually widening to the harbor line at the wharf; from the steamboat wharf to Mill wharf to increase the width an average of 200 feet, with a depth of 8 feet, making an anchorage basin; increasing the width of the lower harbor 40 feet on the north side and widening the upper harbor an average of 360 feet along the channel already dredged to a depth of 8 feet. The estimated cost of the project was \$8,120. It is the existing one.

Of the \$74,000 appropriated by the river and harbor act of June 13, 1902, for certain harbors and rivers on the east shore of Chesapeake Bay, \$3,000 was allotted to the above project. A channel 130 feet wide, 450 feet long, and 8 feet deep at mean low water was dredged during the fiscal year ending June 30, 1904. The river and harbor act of March 3, 1905, appropriated \$44,000 for harbors and rivers on the east shore of Chesapeake Bay. The sum of \$3,120.80 was allotted for this harbor, and dredging under it was commenced in the winter of 1905 and completed in the spring of 1906, resulting in advancing the project width and depth. The river and harbor act of March 2, 1907, appropriated \$60,000 for improvement of rivers and harbors on east shore of Chesapeake Bay, and \$1,531.63 was allotted for this work. A contract for expenditure of funds has been entered into. The amount expended on this improvement to June 30, 1907, is \$56,357.80, of which \$50,237 was on previous projects. Owing to insufficient appropriations the work has been prolonged and the cost of maintenance is added to the original estimate. The estimate of cost of project was increased May 13, 1907, to \$13,858.25. The project is about one-half completed.

The maximum draft that could be carried June 30, 1907, at mean low water over the shoalest part of the channel below the bridge was 10 feet, and about 8 feet above as far as the channel has been dredged.

Six steamers and 130 sailing vessels and barges are reported to ply in the harbor, the commerce being valued at \$4,211,330. The tonnage of the river is reported to be as follows: 1903, 101,552; 1904, 102,568; 1905, 103,697; 1906, 101,662. The improvement has made no appreciable difference in freight rates.

July 1, 1906, balance unexpended.....	\$67.59
Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	1,531.63
	<hr/> 1,599.22
June 30, 1907, amount expended during fiscal year, for works of im- provement.....	67.59
	<hr/> 1,531.63
July 1, 1907, balance unexpended.....	1,378.47
Amount (estimated) required for completion of existing project.....	6,205.82

(e) *Chester River, Maryland, from Crumpton to Jones Landing.*—Before operations were undertaken on this part of the river vessels at low tide drawing 6 feet of water could reach Crumpton, 33 miles above the mouth, and from that point to Jones Landing (to which point the stream is navigable in fact),  $6\frac{1}{4}$  miles, the controlling depth was 3 feet, with a mean range of tide of 1.2 feet. The project for improvement, adopted October 21, 1890, is for a 6-foot low-water channel from Crumpton to Jones Landing, at an estimated cost of \$12,750, increased in 1896 to \$14,250, and still later to \$19,562.50. There has been but one project for this section of the river.

The river and harbor act of March 2, 1907, appropriated \$60,000 for improvement of rivers and harbors on east shore of Chesapeake Bay, and \$2,417.36 was allotted for this work. A contract for expenditure of funds for maintenance has been entered into. The balance in hand will be expended for maintenance. The amount expended on this improvement to June 30, 1907, is \$20,847, of which \$3,439.82 was for maintenance. The project is practically completed, and the additional work required is for maintenance.

The maximum draft that could be carried June 30, 1907, at mean low water over the shoalest part of the river was 5 feet.

The tonnage of the past calendar year, consisting mainly of agricultural products, is reported to be 48,199, valued at \$2,754,970, and is carried on by 6 steamers and 175 sailing vessels and barges. The improvement has made no appreciable difference in freight rates.

It is proposed to apply the available balance to removing shoals that have formed in the channel since it was dredged.

July 1, 1906, balance unexpended.....	\$49.51
Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	2,417.36
	<hr/>
	2,466.87
June 30, 1907, amount expended during fiscal year, for works of improvement .....	49.51
	<hr/>
July 1, 1907, balance unexpended.....	2,417.36
	<hr/>
July 1, 1907, amount covered by uncompleted contracts.....	2,175.63

(f) *Choptank River, Maryland.*—Before improvements were begun in 1879 the depth of water in the channel between Denton and Greensboro varied from 2 to 8 feet, with a mean range of tide of about 2 feet. Navigation, carried on by small sailing vessels, extended to only 3 miles above Denton. Upon the remaining 5 miles to Greensboro, the head of navigation, all freight had to be transported upon scows. Greensboro is about 46 miles above the mouth of the river.

A project for improvement was made in 1880 for an 8-foot low-water channel 75 feet wide, at an estimated cost of \$79,000. At the close of the fiscal year 1903 the project channel had been completed, except for a distance of about 1 mile at the upper end, but there has been some shoaling since. No dredging was done in 1904. The river and harbor act of March 3, 1905, appropriated \$44,000 for rivers and harbors on the east shore of Chesapeake Bay, and \$7,885 was allotted for this river. These funds were applied toward completing the project at its upper end and to removing some shoals

which had formed below. The work was done under contract in the winter of 1905-6. The river and harbor act of March 2, 1907, appropriated \$60,000 for improvement of rivers and harbors on east shore of Chesapeake Bay, and \$9,662.55 was allotted for this work. A contract for expenditure of funds has been made. About one-eighth of the project remains to be done.

The maximum draft that could be carried June 30, 1907, at mean low water over the shoalest part of the channel under improvement was 6 feet. The amount expended on this improvement to June 30, 1907, was \$70,885, of which \$3,495.79 was for maintenance.

Six steamers and 246 sailing vessels and barges are reported as plying in the river, the commerce being valued for the past year at \$8,883,285. The tonnage of the river is reported to be as follows: 1903, 208,367; 1904, 210,447; 1905, 212,725; 1906, 208,496.

The improvement has made no appreciable difference in freight rates.

It is proposed to apply the available balance to completing the channel and to maintenance.

July 1, 1906, balance unexpended -----	\$55. 15
Amount allotted from appropriation by river and harbor act approved March 2, 1907 -----	9, 662. 55
	<hr/>
	9, 717. 70
June 30, 1907, amount expended during fiscal year, for works of im- provement -----	55. 15
	<hr/>
July 1, 1907, balance unexpended -----	9, 662. 55
	<hr/>
July 1, 1907, amount covered by uncompleted contracts -----	8, 696. 30
Amount (estimated) required for completion of existing project----	1, 948. 24

(g) *Warwick River, Maryland.*—This river, formerly named Secretary Creek, is in Dorchester County, eastern shore of Maryland, and flows into the Choptank River, one of the largest tributaries of Chesapeake Bay. It is a small tidal basin 2 miles long, with no fresh-water influx at the head, and was originally only 4 feet deep. The average rise of tide is 2 feet. The original project for the stream is dated January 20, 1880.

Before the adoption of the present project about \$12,000 had been expended in the improvement of this river—\$6,000 by the General Government and the remainder by private parties. The existing project for improvement, based upon a survey in 1891 (printed in Annual Report for 1891, p. 1219), provides for a channel 100 feet wide and 10 feet deep at mean low water from the 10-foot depth in Choptank River to Secretary Landing, at the head of the river, including a turning basin at the latter point, at an estimated cost of \$18,600. Up to July, 1903, dredging had been done from time to time as funds became available until the project was practically completed, but shoals formed rapidly. These were partially removed with \$1,909 allotted from the appropriation of \$44,000 appropriated March 3, 1905, for rivers and harbors on the east shore of Chesapeake Bay. The work was done under contract in December, 1905. The river and harbor act of March 2, 1907, appropriated \$60,000 for improvement of rivers and harbors on east shore of Chesapeake Bay, and \$3,493.87 was allotted to this work. A contract for the work has been entered into.

The amount expended on present project to June 30, 1907, is

\$17,909, of which \$1,868.18 was for maintenance. The project is about eight-ninths completed. The maximum draft that could be carried June 30, 1907, at mean low water over the shoalest part of the channel under improvement was 9 feet.

Six steamers and 78 sailing vessels and barges are reported as plying in the river, the commerce being valued at \$2,431,286.

The tonnage of the river is reported to be as follows: 1903, 65,206; 1904, 65,858; 1905, 66,631; 1906, 60,027.

The improvement has made no appreciable difference in freight rates.

July 1, 1906, balance unexpended.....	\$40.82
Amount allotted from appropriation by river and harbor act approved	
March 2, 1907 .....	3,493.87
	<hr/>
	3,534.69
*June 30, 1907, amount expended during fiscal year, for works of improvement .....	40.82
	<hr/>
July 1, 1907, balance unexpended .....	3,493.87
	<hr/>
July 1, 1907, amount covered by uncompleted contracts.....	3,144.49

(h) *Pocomoke River, Maryland.*—This river has been under improvement by the General Government since 1878, the original project being dated November 19, 1878. In 1879 and 1880, \$12,500 was expended on work below Snow Hill, chiefly in the rectification of the channel and in giving increased width, the depth being 7 feet at mean low water. In 1888, with an appropriation of \$8,000, a cut-off was made through the low neck of land forming four abrupt bends just below Snow Hill. At the close of these operations there was a channel not less than 80 feet wide and 7 feet deep between Snow Hill and Shad Landing, a distance of about  $4\frac{1}{2}$  miles.

The existing project, dated October 1, 1896, is based upon a survey made in 1894-95 (printed in Annual Report for 1895, p. 1167) and is for dredging the channel between Snow Hill and Shad Landing to a depth of 9 feet at mean low water and a width of from 100 to 130 feet, at an estimated cost of \$14,000. The mean range of tide is  $2\frac{1}{2}$  feet. Snow Hill is the head of navigation on this stream and is about 28 miles above the mouth. With funds provided from 1897 to 1904 the channel was dredge to the project dimensions.

The river and harbor act of March 2, 1907, appropriated \$60,000 for improvement of rivers and harbors on east shore of Chesapeake Bay and \$2,298.60 was allotted to this work. A contract for expenditure of funds for maintenance has been made.

To the end of the fiscal year \$35,043 has been expended for the improvement of this river, of which \$20,500 was on previous projects and \$272.27 for maintenance. The project is completed, and the additional work required is for maintenance.

The maximum draft that could be carried June 30, 1907, at mean low water over the shoalest part of the channel under improvement was 9 feet.

Two steamers and 86 sailing vessels and barges are reported as plying in the river, the commerce being valued at \$3,022,840. The tonnage of the river is reported to be as follows: 1903, 245,568; 1904, 246,223; 1905, 67,165; 1906, 65,710.

The improvement has made no appreciable difference in freight rates.

July 1, 1906, balance unexpended.....	\$39. 06
Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	2, 298. 60
	<hr/> 2, 337. 66
June 30, 1907, amount expended during fiscal year, for works of im- provement.....	39. 06
July 1, 1907, balance unexpended.....	<hr/> 2, 298. 60
July 1, 1907, amount covered by uncompleted contracts.....	2, 068. 74

(i) *La Trappe River, Maryland.*—This stream, formerly known as Dividing Creek, has a length of about 3 miles and is a tributary of Choptank River. The head of navigation is at Trappe Landing. The controlling depth prior to 1893 was 4 feet, with a mean range of tide of 18 inches, but was afterwards increased to 8 feet by dredging, under private subscription. The original project is the existing one, adopted August 5, 1892, and is for a channel 150 feet wide and 11 feet deep at mean low water across the bar at the mouth and for a width of 75 feet and a depth of 8 feet inside the bar as far as Trappe Landing, with a turning basin at the latter point, at an estimated cost of \$7,250, subsequently increased to \$9,750. The project has been completed and the additional work required is for maintenance.

The river and harbor act of March 2, 1907 appropriated \$60,000 for improvement of rivers and harbors on east shore of Chesapeake Bay, and \$2,135.39 was allotted for this work. A contract has been made for expenditure of funds for maintenance. The amount expended to June 30, 1907, is \$9,117.50, of which \$1,153.63 was for maintenance.

The maximum draft that could be carried June 30, 1907, at mean low water over the shoalest part of the channel, was 7 feet. Three steamers and 81 sailing vessels and barges are reported as plying in the river, the commerce being valued at \$523,681.

The tonnage of the river is reported to be as follows: 1903, 11,466; 1904, 13,601; 1905, 13,848; 1906, 13,588.

The improvement has made no appreciable difference in freight rates.

July 1, 1906, balance unexpended.....	\$34. 02
Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	2, 135. 39
	<hr/> 2, 169. 41
June 30, 1907, amount expended during fiscal year, for works of im- provement.....	34. 02
July 1, 1907, balance unexpended.....	<hr/> 2, 135. 39
July 1, 1907, amount covered by uncompleted contracts.....	1, 921. 85

(j) *Manokin River, Maryland.*—Before improvements were commenced in 1891 the depth of water at the mouth of the river at the so-called "Mud flats" was between 1 and 2 feet at low tide. These flats are about 2½ miles wide and make navigation impossible except at high water, thereby rendering the upper part of the river, which has a very fair depth and width, almost useless for extensive shipping purposes. The average rise of tide at the flats is 2.6 feet. Princess

Anne is the head of navigation and is about 12 miles above the mouth of the river.

The project was adopted in 1890 and is based upon a survey made in August and September, 1889. (Report printed in Annual Report for 1890, p. 961.) It provides for a channel 6 feet deep at mean low water and 100 feet wide from Locust Point to Sharps Point, a distance of about  $2\frac{1}{2}$  miles and embracing the section called the "Mud flats," at an estimated cost of \$30,000. From 1891 to 1900 dredging on the whole project was done at various times as funds became available. At the close of these operations there was a channel 6 feet deep from Sharps Point to about a mile above Dashiells Creek and a slightly less depth to the steamboat wharf above, and at the mouth soundings taken over the area formerly dredged showed a range of depth from 4.5 to 7.3 feet. No work was done afterwards until the enactment of the river and harbor act of March 3, 1905, which contained an appropriation of \$44,000 for rivers and harbors on the east shore of Chesapeake Bay. The sum of \$4,772.50 of this appropriation was allotted to this river and dredging was done under contract in the autumn of 1905, which consisted in removing shoals that had formed, and resulted in a controlling depth of but 3 feet.

The creation and maintenance of a channel across the Mud flats at the mouth of this river is a work of some difficulty and uncertainty under the method adopted, which was originally considered as tentative only and the best that the commercial importance of the project would justify. Funds have not been available for adequate maintenance and the channel has deteriorated rapidly. The estimate of cost of project was increased May 13, 1907, to \$42,103.99. The river and harbor act of March 2, 1907, appropriated \$60,000 for improvement of rivers and harbors on east shore of Chesapeake Bay, and \$9,160.69 was allotted for this work. A contract for expenditure of funds has been made.

The amount expended on the improvement to June 30, 1907, is \$27,272.50 and \$2,000 additional was expended on the upper river, which is not included in the existing project. The amount expended for maintenance was \$4,728.36. About three-fifths of the project is completed. The maximum draft that could be carried June 30, 1907, at mean low water over the shoalest part of the channel at the mouth was 2 feet.

It was impracticable to obtain commercial statistics, but it is reported that the commerce has increased between 5 and 10 per cent over that reported for 1896, which was 32,076 tons, valued at \$522,990. The improvement has made no appreciable difference in freight rates.

It is proposed to apply the balance available toward completing the project.

July 1, 1906, balance unexpended .....	\$44. 14
Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	9, 160. 69
	<hr/>
	9, 204. 83
June 30, 1907, amount expended during fiscal year, for works of improvement.....	44. 14
	<hr/>
July 1, 1907, balance unexpended .....	9, 160. 69
	<hr/>
July 1, 1907, amount covered by uncompleted contracts.....	8, 244. 62
Amount (estimated) required for completion of existing project.....	10, 399. 16

(k) *Tyaskin Creek*.—This stream is also known as Wetipquin Creek, or River. It is a small tributary of Nanticoke River, having a length of about 5 miles. The controlling depth in the creek was 8 feet, but on the bar at the mouth it was but  $3\frac{1}{2}$  feet at mean low water, with an average rise and fall of the tide of 3 feet. A survey was made in 1899 (report printed in Annual Report for 1900, p. 1681). The existing project, which is the original one, is for a channel 9 feet deep at mean low water, with a width of 120 feet, at an estimated cost of \$13,200. Dredging was done in the fiscal year ending June 30, 1904, and resulted in making a 9-foot navigation at mean low water to the wharf at Tyaskin, the head of navigation, but the channel was only 60 feet wide. The sum of \$2,158 was allotted for this creek from the appropriation of \$44,000, March 3, 1905, for rivers and harbors on the east shore of Chesapeake Bay. The channel was widened with these funds to 90 feet for a distance of 1,270 feet. Under a survey made in January, 1906, the estimate of cost of completion of this project, with a suitable turning basin added, is \$6,462.39. The river and harbor act of March 2, 1907, appropriated \$60,000 for improvement of rivers and harbors on the east shore of Chesapeake Bay, and \$6,500 was allotted to complete this work. A contract has been made for completion. The amount expended to June 30, 1907, is \$10,158. The project is about five-eighths completed. The maximum draft that could be carried June 30, 1907, at mean low water over the shoalest part of the channel was 8 feet.

Three steamers and 35 sailing vessels and barges are reported as plying in the creek, the commerce being valued at \$45,500. The tonnage of the creek is reported to be as follows: 1903, 784; 1904, 796; 1905, 856; 1906, 945.

The improvement has made no appreciable difference in freight rates.

Reference to reports on examination and survey required by the river and harbor act of March 3, 1905, will be found on page 214 of the Report of the Chief of Engineers for 1906.

July 1, 1906, balance unexpended .....	\$25. 84
Amount allotted from appropriation by river and harbor act approved March 2, 1907 .....	6, 500. 00
	<hr/>
	6, 525. 84
June 30, 1907, amount expended during fiscal year, for works of improvement .....	25. 84
	<hr/>
July 1, 1907, balance unexpended .....	6, 500. 00
	<hr/>
July 1, 1907, amount covered by uncompleted contracts .....	5, 850. 00

## CONSOLIDATED.

July 1, 1906, balance unexpended -----	\$356. 13
Amount appropriated by river and harbor act approved March 2, 1907. -----	60, 000. 00
	<hr/> 60, 356. 13
June 30, 1907, amount expended during fiscal year, for works of improvement -----	362. 79
	<hr/>
July 1, 1907, balance unexpended -----	59, 993. 34
July 1, 1907, outstanding liabilities -----	6. 95
	<hr/>
July 1, 1907, balance available -----	59, 986. 39
	<hr/>
July 1, 1907, amount covered by uncompleted contracts -----	54, 000. 03
Amount (estimated) required for completion of existing project -----	53, 536. 46

(See Appendix J 6.)

7. *Nanticoke River, Delaware and Maryland.*—This river is a tidal stream, its headwaters consisting of numerous branches rising mainly in the northern section of Sussex County, Del. The river flows in a southwesterly direction into Tangier Sound, Chesapeake Bay, and the interests for the improvement of the river center at Seaford, the head of navigation, 36 miles from the mouth, where the range of tide is about 3.4 feet.

The river and harbor act of August 18, 1894, appropriated \$5,000 for improving Broad Creek River, Delaware, a branch of Nanticoke River, and provided that as much of it as might be necessary should be used for the removal of the bar extending from the railroad bridge at Seaford toward the mouth of Nanticoke River. With this appropriation the channel was dredged where necessary to a width of 100 feet and a depth of 9 feet at mean low water from the south side of the railroad bridge at Seaford to a point 8,000 feet below. A previous appropriation for the Nanticoke River in 1886 was, in accordance with the terms of the law, applied to Broad Creek River up to Laurel.

The existing project for the improvement of the Nanticoke River is based upon a survey made in 1895 (printed in Annual Report of the Chief of Engineers for 1895, pp. 1165 to 1167) and is for a channel 9 feet deep at mean low water and 100 feet wide, the width to be increased to about 150 feet at sharp turns of the channel, the improvements to be extended to within 100 feet of the county bridge, where the proposed channel is to widen out fan-shaped, at an estimated cost of \$13,000. The project is practically completed, and the additional work required is for maintenance.

The river and harbor act of March 2, 1907, contained an appropriation of \$2,000 for this work, and a contract for maintenance has been entered into.

The amount expended to June 30, 1907, was \$13,000, of which \$5,000 was on a previous project and \$2,429.26 for maintenance.

The maximum draft that could be carried June 30, 1907, at mean low water over the shoalest part of the channel was 8½ feet. Three steamers and 120 sailing vessels and barges are reported as plying in the river, the commerce being valued at \$4,351,380. The tonnage of the river is reported to be as follows: 1903, 119,038; 1904, 120,229; 1905, 121,769; 1906, 119,348.



The improvement has made no appreciable difference in freight rates.

July 1, 1906, balance unexpended .....	\$208. 38
Amount appropriated by river and harbor act approved March 2, 1907.....	2, 000. 00
	<hr/>
	2, 208. 38
June 30, 1907, amount expended during fiscal year, for works of improvement.....	208. 38
	<hr/>
July 1, 1907, balance unexpended .....	2, 000. 00
July 1, 1907, outstanding liabilities.....	16. 55
	<hr/>
July 1, 1907, balance available.....	1, 983. 45
	<hr/>
July 1, 1907, amount covered by uncompleted contracts.....	1, 800. 00
(See Appendix J 7.)	

8. *Broad Creek River, Delaware.*—This is a tributary of the Nanticoke River, and in 1881 the controlling depth was  $1\frac{1}{2}$  feet, with a mean range of tide of 3 feet. In 1889 a channel 6 feet deep at mean low water and 50 feet wide had been dredged under project dated February 4, 1880, from Bethel to Laurel, the head of navigation, about  $7\frac{1}{2}$  miles from the mouth of the river, at a cost of \$35,000. The existing project, adopted August 5, 1892, is for a channel 70 feet wide and 8 feet deep at mean low water between Bethel and Laurel, at an estimated cost of \$15,000. The projected channel was dredged except for a short distance at the upper end, where it was reduced to 60 feet in width to secure the stability of some wharves. No dredging was done in the fiscal year 1907. The river and harbor act of March 2, 1907, appropriated \$1,500 for maintenance, and contract has been entered into. The amount expended to June 30, 1907, is \$15,000. The project is completed, and the additional work required is for maintenance.

The maximum draft that could be carried June 30, 1907, at mean low water over the shoalest part of the channel is reported to be 6 feet.

One steamer, 10 yachts, and 500 sailing vessels are reported as plying in the river, the commerce being valued at \$618,650. The tonnage of the river for 1906 is reported to be 29,090. The improvement is reported to have made a reduction of 50 per cent in freight rates.

Amount appropriated by river and harbor act approved March 2, 1907.....	\$1, 500. 00
	<hr/>
July 1, 1907, balance unexpended.....	1, 500. 00
July 1, 1907, outstanding liabilities.....	13. 55
	<hr/>
July 1, 1907, balance available.....	1, 486. 45
	<hr/>
July 1, 1907, amount covered by uncompleted contracts.....	1, 350. 00

(See Appendix J 8.)

9. *Wicomico River, Maryland.*—The portion of the river at and just below Salisbury, which is the head of navigation and 23 miles from the mouth, has been under improvement by the United States since 1872, under project dated April 15, 1871. The average rise and fall of tide is 3 feet. At that time the navigable channel, with a minimum depth of 8 feet at low water, extended to a point within 2 miles of Salisbury. The extreme upper portion, as far as the milldam in the heart of the town, was quite shoal, and has an average depth of only

18 inches at low tide. Between 1872 and 1885 a channel 75 to nearly 100 feet wide and 7 feet deep at low water was dredged from deep water below to the drawbridge in the town, at a cost to the Government of about \$50,000.

The existing project, based upon a survey of the river made in 1889 (printed in Annual Report for 1890, pp. 947-950), provides for a channel 9 feet deep at mean low water from that depth below to the drawbridge at Salisbury, the width to be from 100 to 150 feet, at an estimated cost of \$23,200. At the time this project was adopted there existed a 7-foot low-water channel from 75 to 100 feet wide to Salisbury. The project has been practically completed, and the additional work required is for maintenance.

The river and harbor act of March 2, 1907, appropriated \$2,500 for maintenance of this river, and a contract has been entered into to do the work. The amount expended to June 30, 1907, is \$84,998, of which \$50,000 was on previous projects and \$4,942.24 for maintenance. The maximum draft that could be carried June 30, 1907, at mean low water over the shoalest part of the channel under improvement was 8½ feet.

Two steamers and 80 sailing vessels and barges are reported as plying in the river, the commerce being valued at \$7,422,620. The tonnage of the river is reported to be as follows: 1903, 197,306; 1904, 199,279; 1905, 202,510; 1906, 198,451.

The improvement has made no appreciable difference in freight rates.

Reference to reports on examination and survey of the river required by the river and harbor act of March 3, 1905, will be found on page 215 of the Report of the Chief of Engineers for 1906.

It is proposed to apply the available balance to maintenance in redredging shoals that formed since original dredging was done.

July 1, 1906, balance unexpended.....	\$57. 76
Amount appropriated by river and harbor act approved March 2, 1907.....	2, 500. 00

2, 557. 76

June 30, 1907, amount expended during fiscal year, for works of improvement .....	57. 76
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July 1, 1907, balance unexpended.....	2, 500. 00
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July 1, 1907, amount covered by uncompleted contracts.....	2, 250. 00
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(See Appendix J 9.)

10. *Crisfield Harbor, Maryland.*—This harbor is situated at Somers Cove, Little Annemessex River, which at this point is an estuary of Tangier Sound, on the east side of Chesapeake Bay. It is the principal port of the collection district of eastern Maryland. Crisfield is the head of navigation of the harbor and is 1 mile from its mouth. The length of the navigable portion of the harbor is 1½ miles. Originally the harbor had a controlling depth of 8½ feet at mean low water for a width of 400 feet, with a mean rise and fall of tide of 2.6 feet, but this was not deemed adequate for the commerce of the port. The original project adopted March 3, 1875, was for a channel 266 feet wide and 12 feet deep at mean low water from above the railroad wharf to a point known as the second angle, opposite Somers Cove

light, and from that point to deep water below, a channel of the same depth 425 feet wide, and in addition a basin on both the north and south sides of the railroad wharf 12 feet deep, at an estimated cost of \$37,317.50. The act of March 3, 1875, made the appropriation, and the work was completed May, 1876. No dredging has been done since, and the work has been without maintenance for about thirty years.

The act of March 3, 1905, authorized a survey, which was made in December, 1905, the report thereon being printed in House Document No. 783, Fifty-ninth Congress, first session. The existing project, approved March 2, 1907, is to restore the channel formerly dredged and to restore and widen the anchorage basin, at an estimated cost of \$37,706.62, and an annual cost for maintenance of \$800. The river and harbor act of March 2, 1907, made an appropriation of \$37,707 for the completion of this project, and a contract has been entered into for the work. Nothing has been expended on existing project to June 30, 1907.

The maximum draft that could be carried June 30, 1907, at mean low water over the shoalest part of the channel under improvement was 8 feet.

Eight steamers and 350 sailing vessels and barges are reported as plying in the harbor, the commerce being valued at \$1,242,860. The tonnage of the harbor is reported to be 30,265 for the year 1906.

A report on a survey of this harbor is to be found beginning on page 105, Part 2, Annual Report of the Chief of Engineers for 1875. Amount appropriated by river and harbor act approved March 2, 1907. \$37, 707. 00

July 1, 1907, balance unexpended.....	37, 707. 00
July 1, 1907, outstanding liabilities.....	36. 95
July 1, 1907, balance available.....	37, 670. 05
July 1, 1907, amount covered by uncompleted contracts.....	33, 936. 30

(See Appendix J 10.)

*11. Removing sunken vessels or craft obstructing or endangering navigation.*—During the past fiscal year the following wreck was removed: Schooner *Edward Wright* from Chesapeake Bay near Bloody Point light-house, Maryland, at a cost of \$550.

EXAMINATION OF ROUTE FOR A WATERWAY TO CONNECT THE WATERS OF THE CHESAPEAKE AND DELAWARE BAYS, INCLUDING THE "SASSAFRAS" ROUTE, MADE IN COMPLIANCE WITH JOINT RESOLUTION OF CONGRESS APPROVED JUNE 28, 1906.

Report dated January 1, 1907, by a Commission appointed by the President to examine and report upon a route for the construction of a free and open waterway to connect the waters of the Chesapeake and Delaware bays, including the *Sassafras* route, required by joint resolution of Congress approved June 28, 1906, was submitted to Congress and printed in Senate Document No. 215, Fifty-ninth Congress, second session. The route selected is that of the present Chesapeake and Delaware Canal, the works, franchises, etc., thereof being appraised at \$2,514,289.70.

IMPROVEMENT OF POTOMAC RIVER AND ITS TRIBUTARIES, OF JAMES RIVER AND OF HARBOR AT MILFORD HAVEN, VIRGINIA, AND OF CERTAIN RIVERS IN MARYLAND AND VIRGINIA ON THE WESTERN SHORE OF CHESAPEAKE BAY; CONSTRUCTION OF PIERS, HAMPTON ROADS, JAMESTOWN EXPOSITION; PERMANENT LANDING PIER, JAMESTOWN ISLAND, VIRGINIA.

This district was in the charge of Maj. Spencer Cosby, Corps of Engineers, to September 11, 1906; in the temporary charge of First Lieut. E. J. Dent, Corps of Engineers, from September 11, to November 18, 1906, and in the charge of Major Cosby since November 18, 1906, the district officer having Lieutenant Dent under his immediate orders to September 11, and since November 18, 1906. Division engineer, Col. Amos Stickney, Corps of Engineers, until June 4, 1907, and Col. D. W. Lockwood, Corps of Engineers, since that date.

1. *Potomac River at Washington, D. C.*—Before improvement the Virginia channel was obstructed by two bars. The upper bar extended upstream from Long Bridge to about one-half mile below Easby Point, and the ruling depth on this bar was 8 feet. The lower bar was near Giesboro Point and had a ruling depth of 14 feet. The ruling depth in the Washington channel was 10 feet. Georgetown Harbor was obstructed by several dangerous rocks. The flats, which extended to the edge of the Virginia channel, were largely bare at low water and were an active agent in spreading malarial and other diseases.

Between June 11, 1870, and March 3, 1881, the sum of \$290,000 was appropriated by Congress for the improvement of the harbors of Washington and Georgetown. The project under which this sum was expended is not definitely stated, although it is understood that it provided for dredging channels 16 feet deep and 200 feet wide through the Georgetown and Washington channels, and for the removal of the most dangerous rocks obstructing navigation in the harbor of Georgetown to a depth of 20 feet.

The existing project for the improvement was adopted August 2, 1882, and has for its object the improvement of the navigation of the river by widening and deepening its channels, the reclamation of the flats by depositing on them the material dredged from the channels, the freeing of the Washington channel of sewage, and the establishment of harbor lines. To effect these the project provided "that the channel depths \* \* \* should be sufficient to accommodate the largest draft vessels that can be brought up to Arsenal Point" (the projected depth was not stated in feet, but by the above-imposed condition was at that time limited to 20 feet at low tide, whereas the ruling depth in the Potomac River below Washington has now been increased by dredging to 24 feet at low tide), that the flats be reclaimed to a height of 3 feet above the flood plane of 1877 (which, although the highest recorded freshet at that time, was exceeded by about 3 feet by the flood of 1889), and for a tidal reservoir to be provided with automatic inlet and outlet gates. A training dike on the Virginia shore extending downstream from Analostan Island was added to the project in 1890. The project also provided for the rebuilding of Long Bridge and for the interception of all sewage discharged into the Washington channel, but neither of these works was included in the estimated cost of the improvement, which was \$2,716,365. The estimate as revised in 1897 is \$2,953,020.

The amount expended on the work of the existing project to June 30, 1907, was \$2,531,764.59, of which \$329,934.35 has been applied to maintenance since March 3, 1899, and 50 cents was derived from the sale of blueprints.

The expenditure resulted in the dredging of a channel 20 feet deep and 550 feet wide through the bar above Long Bridge, in increasing the width of the natural channel just below Long Bridge by 50 to 500 feet and in deepening it to 20 feet; in dredging a channel 350 feet wide and 20 feet deep through the bar in the Virginia channel near Giesboro Point; in dredging the Washington channel to a width of 400 feet and a depth of 20 feet; in dredging between this navigation channel and the wall of the adjacent reclaimed area to a depth of 12 feet; in dredging at the junction of the Washington and Virginia channels; in dredging the tidal reservoir (111 acres) to a depth of about 8 feet; in several times redredging cuts 20 feet deep through bars which had re-formed by freshet action in the Virginia and Washington channels; in the completion of the reservoir outlet; in the construction of 35,289 linear feet of sea wall, of which 7,066 linear feet has been taken down and relaid, and in the building of 5,965 linear feet of training dike.

The area of land reclaimed by these operations is 621.12 acres (or, including reservoir, 739.42 acres), which by act of March 3, 1897, was declared to be a public park under the name of Potomac Park. The entire project is now about two-thirds completed.

The work of maintenance during the fiscal year ended June 30, 1907, consisted in partly redredging the Washington channel; in repairing the wharf at Easby Point; in making preparations for additional redredging, and in general maintenance of the improvement and care of property.

The maximum draft that could be carried June 30, 1907, at mean low water over the shoalest part of the Washington channel was 21 feet; for the Virginia channel it was 17 feet. The mean range of tide is about 3 feet.

The Potomac River is navigable to the foot of Little Falls,  $3\frac{1}{2}$  miles above Georgetown, but the Aqueduct Bridge, which crosses the river at Georgetown, 113 miles above the mouth of the river, has no draw and limits the navigation of large steamers and masted vessels.

The principal articles of commerce are sand and gravel, coal, lumber, ice, cord wood, stone, oils, oysters, bricks, coke, and general merchandise. The receipts and shipments during 1906 amounted to about 907,000 tons and were estimated to be worth about \$8,609,860. This is the largest tonnage ever reported.

The benefits to navigation from the improvements made have been marked. Vessels of much deeper draft than those formerly used are now engaged in this trade, and it is understood that freight rates have been materially reduced.

The additional work proposed is for the purpose of extension of benefits and for the maintenance of the improvement in a serviceable condition.

Maps of the locality may be found in each Annual Report of the Chief of Engineers since 1877, with the exception of those for 1879, 1882, 1893, and 1905.

Reference to the report on the examination and survey of Potomac River at Washington, D. C., will be found on page 194 of the Annual Report of the Chief of Engineers for 1904.

July 1, 1906, balance unexpended.....	\$47, 552. 83
Amount appropriated by river and harbor act approved March 2, 1907.....	258, 000. 00
Received from sale of blueprints.....	. 50

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305, 553. 33

June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	45, 317. 42
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July 1, 1907, balance unexpended.....	260, 235. 91
July 1, 1907, outstanding liabilities.....	221. 80

July 1, 1907, balance available.....	260, 014. 11
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Amount (estimated) required for completion of existing project.....	490, 954. 35
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(See Appendix K 1.)

2. *Potomac River below Washington, D. C.*—The Potomac River below Washington, D. C., is generally a wide and deep body of water, having the characteristics of a tidal estuary rather than of a fluvial stream.

Prior to improvement 24-foot navigation was obstructed by seven shoals, over which the depth ranged from 19½ to 23 feet at low tide. Several of these shoals were long and formed serious obstructions to navigation by deep-draft vessels.

The present, which is also the original, project for this improvement was adopted March 3, 1899. It provides for the improvement of the waterway by dredging channels 24 feet deep and 200 feet wide through all obstructions to 24-foot navigation below Washington, D. C., at an estimated cost of \$176,000.

The amount expended to June 30, 1907, was \$184,836, of which about \$31,000 was applied to maintenance.

As a result of this expenditure channels 24 feet deep and at least 200 feet wide have been dredged through all the shoals.

The work of maintenance during the fiscal year ended June 30, 1907, consisted in making occasional inspections of the locality.

The maximum draft that could be carried on June 30, 1907, at mean low water over the shoalest part of the locality under improvement was 24 feet. The mean range of tide varies from about 1.6 feet at the lower shoals to about 2.8 feet at the upper. Georgetown, 113 miles above the mouth of Potomac River, is the head of navigation for large vessels.

The principal articles of commerce are sand and gravel, coal, lumber, ice, oils, naval ordnance and supplies, cord wood, brick clay, stone, fertilizer, oysters, bricks, phosphate rock, coke, paving blocks, railroad ties, asphalt, potash salt, and general merchandise. The receipts and shipments during 1906 amounted to about 1,284,000 tons, and were estimated to be worth about \$20,116,052.

As far as known the work done has had no material effect upon freight rates.

The work provided for under the present project has been completed, and no further appropriation is required therefor.

Maps of the locality may be found in the Annual Reports of the Chief of Engineers for 1890, 1900, 1902, and 1903.

For reference to the report of an examination and survey of Potomac River below Washington, D. C., see page 197 of the Annual Report of the Chief of Engineers for 1904.

July 1, 1906, balance unexpended	\$1,281.00
June 30, 1907, amount expended during fiscal year, for maintenance of improvement	117.00

July 1, 1907, balance unexpended	1,164.00
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(See Appendix K 2.)

3. *Anacostia River, District of Columbia.*—Before improvement the ruling depth from the mouth to the Navy-Yard Bridge was about 18 feet, the channel affording this depth being narrow and tortuous.

An allotment of \$20,000 for work in the Anacostia was made from the appropriation of September 19, 1890, for improving Potomac River at Washington. Under this allotment channels 20 feet deep and about 200 feet wide were dredged through shoals near the foot of South Capitol street and opposite Washington Barracks. This dredging was completed in May, 1892, at a cost of \$18,536.94.

The present project for this stream was adopted June 13, 1902, and provides for the improvement of the portion of Anacostia River below the Navy-Yard Bridge by dredging a channel 20 feet deep for a width of 400 feet, the depth then gradually decreasing to 6 feet at the bulkhead lines, and by depositing the dredged material on the adjacent flats to an average elevation of 7 feet above low tide, the reclaimed area to be surrounded by an earthen embankment to a height of 14 feet above low tide, protected by a masonry sea wall, and provided with suitable drainage through the embankment, all at an estimated cost of \$1,218,525.

The amount expended on the existing project to June 30, 1907, was \$153,340.41, none of which was applied to maintenance. As a result of this expenditure, a channel 20 feet deep at mean low tide and at least 300 feet wide (except at Buzzard Point, where the width is about 240 feet) has been secured for a distance of 9,130 feet upstream from the mouth of the Anacostia, i. e., up to the center of the navy-yard.

Incidental to the improvement of the channel, about 110 acres of flats has been filled by the deposit of excavated material to an average height of 4 feet above low tide. Harbor lines have been established up to Pennsylvania Avenue Bridge.

A trench has been dredged from the upper end of the existing stone sea wall to Poplar Point and about 2,400 cubic yards of riprap stone has been deposited in this trench, to retain material to be dredged from the channel during the ensuing fiscal year.

The entire project is now about one-eighth completed.

The maximum draft that could be carried on June 30, 1907, over the shoalest part of the locality under improvement was 19 feet. The mean range of tide is about 3 feet.

Anacostia River is navigable for large vessels to the Navy-Yard Bridge, for tugs and small vessels to Pennsylvania Avenue Bridge, and for small scows and lighters to Bladensburg, Md., respectively 2,  $2\frac{1}{4}$ , and  $8\frac{1}{4}$  miles above its mouth.

The principal articles of commerce are sand and gravel, naval ordnance and supplies, brick clay, stone, coal, oils, paving blocks,

and cord wood. The receipts and shipments during 1906 amounted to about 335,000 tons, and were estimated to be worth about \$9,100,000.

The improvement already made has been of benefit to navigation, and has resulted in the diversion of considerable traffic from the Washington channel, where conditions were rapidly becoming congested. It is not known that any reduction in freight rates has resulted from the work done.

The additional work proposed is for the extension of benefits.

Maps of the locality will be found in the Annual Reports of the Chief of Engineers for 1903, 1904, and 1905.

Reference to reports upon examinations and surveys of this river will be found on page 198 of the Annual Report of the Chief of Engineers for 1904.

A report relative to the title to Anacostia flats is printed in House Document No. 194, Fifty-ninth Congress, first session.

Amount appropriated by river and harbor act approved March 2, 1907, \$127, 000. 00  
June 30, 1907, amount expended during fiscal year, for works of improvement ----- 1, 877. 35

July 1, 1907, balance unexpended ----- 125, 122. 65  
July 1, 1907, outstanding liabilities ----- 821. 38

July 1, 1907, balance available ----- 124, 301. 27

July 1, 1907, amount covered by uncompleted contracts ----- 11, 545. 00  
Amount (estimated) required for completion of existing project ---- 940, 061. 94

(See Appendix K 3.)

4. *Breton Bay, Maryland.*—Breton Bay, a tidal estuary of the Potomac River, is about 6½ miles long and well landlocked. Fifteen feet of water can be carried up the bay for a distance of 4 miles. At the time of the adoption of the project for its improvement 10-foot navigation in Breton Bay was obstructed by a shoal commencing 5 miles above the mouth and extending to the head of the bay. The least channel depth over this shoal was 5 feet at low tide.

The original project for improvement, adopted in 1878, provided for dredging a channel 150 feet wide and 9 feet deep from the 9-foot contour in Breton Bay to the Leonardtown wharf, with a turning basin for steamboats at the wharf 400 feet wide and 600 feet long, at an estimated cost of \$30,000. In 1886 the project was amended so as to provide for a channel 200 feet wide and 10 feet deep, the turning basin to be 800 feet long and 400 feet wide. The estimated cost of the amended project was \$49,000. In 1890 the original project was resumed, a width of 150 feet and depth of 9 feet being deemed sufficient to furnish all the facilities needed by navigation at that time.

From June 18, 1878, to September 19, 1890, nine appropriations, aggregating \$37,500, were made. This sum was applied to dredging 214,229 cubic yards of material. The work called for by the project of 1890 was completed August 25, 1891. The channel was then 9 feet deep at low tide from the original 9-foot contour in Breton Bay to the Leonardtown wharf. The width of the channel was 150 feet, and at the turn opposite Buzzard Point it had been increased to 320 feet to facilitate navigation. The basin at Leonardtown was 9 feet deep, 370 feet wide, and 600 feet long.



The present project for this improvement was adopted June 13, 1902, and contemplates the dredging of a channel and turning basin 10 feet deep, the channel to have a minimum width of 200 feet and the turning basin to be 400 feet wide and 600 feet long. The estimated cost of the project is \$36,480.

The Board of Engineers for Rivers and Harbors considered this project and recommended, in report dated September 22, 1903, that \$6,000 be expended at the earliest practicable date in providing a channel 10 feet deep and wide enough to accommodate the boats now trading in this stream, including a turning basin of ample dimensions at Leonardtown wharf, \$4,000 to be applied to new work and \$2,000 to maintenance.

It was the opinion of the Board that the expenditure of \$4,000 every four years thereafter would be enough to maintain a sufficient turning basin and a channel at least 100 feet wide and wider at the turn, all of a 10-foot depth.

The amount expended under the present project to June 30, 1907, was \$10,909.28, of which about \$1,500 was applied to maintenance. As a result of this expenditure there has been dredged a channel from Leonardtown wharf to deep water in Breton Bay 150 feet wide, 10 feet deep, and 6,100 feet long, with a turning basin at its head of the same depth, 275 feet wide and about 500 feet long. The width of the channel is increased to about 220 feet at the turn at Buzzard Point. The project as recommended by the Board of Engineers for Rivers and Harbors is completed, except for maintenance. The work of maintenance during the fiscal year ending June 30, 1907, resulted in restoring a depth of 10 feet in the shoal portion of the previously dredged channel.

The maximum draft that could be carried on June 30, 1907, at mean low water, over the shoalest part of the locality under improvement was 10 feet. The mean range of tides is about 1.7 feet. Leonardtown, 6 miles above the mouth of the bay, is the head of navigation.

The principal articles of commerce are oysters, railroad ties, cord wood, lumber, grain, tobacco, farm produce, coal, and general merchandise. The receipts and shipments during 1906 amounted to about 6,600 tons and were estimated to be worth about \$170,000. The number of passengers carried is about 2,000 a year.

The improvement has been of great benefit to shippers in this vicinity, but as far as known there has been no material reduction in freight rates.

In conformity with the recommendation of the Board of Engineers for Rivers and Harbors no additional appropriation is requested for this locality at present.

Maps of the locality may be found in the Annual Reports of the Chief of Engineers for 1887 and 1889.

For reference to reports on examinations and surveys of this locality see page 199 of the Annual Report of the Chief of Engineers for 1904. For report of Board of Engineers for Rivers and Harbors referred to above see Annual Report of the Chief of Engineers for 1903, page 1045.

July 1, 1906, balance unexpended.....	\$5, 948. 74
June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$3, 358. 02
For maintenance of improvement.....	1, 500. 00
	<hr/> 4, 858. 02
July 1, 1907, balance unexpended.....	1, 090. 72
July 1, 1907, outstanding liabilities.....	523. 85
	<hr/> 566. 87
July 1, 1907, balance available.....	<hr/> 485. 65
July 1, 1907, amount covered by uncompleted contracts.....	
(See Appendix K 4.)	

5. *York, Mattaponi, and Pamunkey rivers, and Occoquan and Carters creeks, Virginia.*—(a) *York River.*—Prior to improvement 24 feet could be carried up York River for a distance of 32 miles, to Potopotank bar, over which the ruling depth was 18½ feet. West Point bar, the only other obstruction to navigation, had a ruling depth of 15½ feet.

The project for this improvement, adopted June 14, 1880, and revised in 1884 and 1887, provides for dredging channels 22 feet deep at mean low water and 400 feet wide through the bars, and for the construction of a dike along the right bank at West Point bar to maintain the channel, at a total estimated cost of \$308,800.

The amount expended to June 30, 1907, was \$249,813.42, of which \$21,890.19 was applied to maintenance subsequent to March 3, 1899. This expenditure has resulted in a dredged channel 105 feet wide and 22 feet deep at Potopotank, and another 22 feet deep and 160 to 260 feet in width at West Point bar. A training dike 10,142 feet long has been constructed at West Point bar, part of which has been rebuilt.

The entire project is now about three-fifths completed.

The maximum draft that could be carried on June 30, 1907, at mean low tide over the shoalest part of the locality under improvement was about 20 feet. The mean range of tides is about 3 feet. York River is navigable throughout its entire length of 41 miles to West Point at its head.

The principal articles of commerce are lumber, oysters, cord wood, tobacco, railroad ties, farm produce, ship timber, piles, and general merchandise. The receipts and shipments during 1906 amounted to about 198,000 tons, and were estimated to be worth about \$6,100,000.

The work done has been of much importance to commerce, and it is understood that freight rates have been somewhat reduced.

The additional work proposed is designed for the preservation of work already done.

Maps of the locality may be found in the Annual Reports of the Chief of Engineers for 1886, 1887, and 1894.

For reference to report on examination and survey of York River see page 201 of the Annual Report of the Chief of Engineers for 1904.

July 1, 1906, balance unexpended.....	\$58. 44
Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	7, 000. 00
	<hr/> 7, 058. 44
July 1, 1907, balance unexpended.....	7, 058. 44
Amount (estimated) required for completion of existing project.....	73, 818. 33

(b) *Mattaponi River*.—The Mattaponi River is navigable for small steamers and vessels from its mouth to Aylett, about 39 miles, and can be made navigable for small barges from Aylett to Monday bridge, 16 miles above. At the time of the adoption of the project the obstructions to a 5½-foot navigation below Aylett consisted of seven bars, upon which the ruling depths at low tide varied from 2.4 to 3.8 feet. Above Aylett there were numerous bars, but no work upon them has been proposed. The river was also obstructed by snags, wrecks, and overhanging trees.

The original project for improvement, adopted June 14, 1880, provided for the removal of snags, wrecks, and leaning trees below Monday bridge and the improvement of the bars below Aylett, so as to give a depth of 5½ feet at low tide and a channel width of 40 feet, at an estimated cost of \$34,059. This project was extended by the terms of the river and harbor act of July 13, 1892, which provided for the removal of snags as far up as Guineas bridge, near Milford station, on the Richmond, Fredericksburg and Potomac Railroad. The estimated cost of this, which is the present project, is \$72,100.

The amount expended to June 30, 1907, was \$31,644.31, of which \$2,194.48 has been applied to maintenance since March 3, 1899. This expenditure resulted in the removal of snags, logs, and overhanging trees from the river between Robinson bar, 34 miles above the mouth, and Monday bridge, and in keeping the river below Aylett free from such obstructions; in constructing 2,297 linear feet of dike at Robinson bar, and in dredging channels of the full projected dimensions entirely through Line Tree and partly through Latané and Walker bars. The entire project is now about one-third completed.

The maximum draft that could be carried at mean low water over the shoalest part of the channel June 30, 1907, was 2.4 feet at Walker bar. The mean range of tide is about 3 feet. Aylett, 39 miles above the mouth of the river, is the present head of navigation.

The principal articles of commerce are lumber, cord wood, farm produce, railroad ties, piles, ship timber, and general merchandise. The receipts and shipments during 1906 amounted to about 80,000 tons, and were estimated to be worth about \$827,000.

The work done has been of considerable benefit to commerce, and it is understood that not only have shipments been facilitated, but that freight rates have been somewhat reduced.

The additional work proposed is partly necessary to make the improvement available, partly for the purpose of extension of benefits, and partly for the preservation of work already done.

Maps of the locality may be found in the Annual Reports of the Chief of Engineers for 1887, 1888, and 1890.

For reference to reports on examinations and surveys of this locality see page 212 of the Annual Report of the Chief of Engineers for 1904.

July 1, 1906, balance unexpended .....	\$5, 755. 85
Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	6, 500.00
	<hr/> 12, 255. 85
June 30, 1907, amount expended during fiscal year, for works of im- provement.....	1, 300. 16
July 1, 1907, balance unexpended.....	<hr/> 10, 955. 69
July 1, 1907, amount covered by uncompleted contracts.....	2, 622. 66
Amount (estimated) required for completion of existing project.....	31, 694. 48

(c) *Pamunkey River*.—At the time of the adoption of the project for the improvement of Pamunkey River, a draft of 7 feet could be carried at low tide to Buckland bar,  $38\frac{1}{2}$  miles above its mouth. Between this bar and Hanover town, a distance of  $20\frac{1}{2}$  miles, there were six bars, the ruling depths on which varied from  $5\frac{1}{2}$  to 2 feet. Besides these bars the river was obstructed by wrecks, logs, snags, and overhanging trees.

The original, which is also the existing, project for the improvement of this river was adopted June 14, 1880, and amended in 1885. It contemplates securing 7-foot navigation to Bassett Ferry, 47 miles above West Point; thence 5-foot navigation to Wormley Landing, 7 miles upstream; thence 3-foot navigation to Hanover town, 5 miles farther; the 7-foot channel to have a width of 100 feet and the other channels a width of 40 feet. The wrecks, snags, logs, and trees obstructing navigation between Garlick Ferry and Hanover town were also to be removed. The estimated cost of this project is \$32,500.

The amount expended to June 30, 1907, was \$27,075.87, of which \$2,872.05 was applied to maintenance after March 3, 1899. This expenditure has resulted in removing snags and similar obstructions from about 30 miles of river, in keeping it free from such obstructions, in removing parts of 7 wrecks, in partly improving Spring and Skidmore bars, and in dredging a channel 100 feet wide and 7 feet deep through Buckland bar.

The entire project is now about one-half completed.

The work of maintenance during the fiscal year ended June 30, 1907, consisted in examining an obstructed thoroughfare.

The maximum drafts that could be carried through the channels on June 30, 1907, at mean low tide were as follows: In the 7-foot channel, 5.3 feet; in the 5-foot channel, 3.5 feet, and in the 3-foot channel 2.2 feet. The mean range of tide varies from 2 to 3.5 feet. Hanover town, 59 miles above the mouth of the river, is the head of navigation.

The principal articles of commerce are lumber, cord wood, railroad ties, ship timber, salt, and grain. The receipts and shipments during 1906 amounted to about 40,000 tons and were estimated to be worth about \$295,000.

The work done has been of benefit to commerce, and it is understood that not only have shipments been facilitated, but freight rates have been reduced.

The additional work proposed is for maintenance and preservation of the work already done.

Maps of the locality may be found in the Annual Reports of the Chief of Engineers for 1887, 1888, and 1890.

For reference to the report on an examination and survey of Pamunkey River, see page 213 of the Annual Report of the Chief of Engineers for 1904.

July 1, 1906, balance unexpended.....	\$2, 923. 83
Amount allotted from appropriation by river and harbor act approved	
March 2, 1907.....	5, 500. 00
	<hr/>
	8, 423. 83
June 30, 1907, amount expended during fiscal year, for maintenance of improvement .....	99. 70
	<hr/>
July 1, 1907, balance unexpended.....	8, 324. 13
	<hr/>
July 1, 1907, amount covered by uncompleted contracts .....	2, 340. 00

(d) *Occoquan Creek*.—In 1872 navigation in Occoquan Creek, a tributary of the Potomac River, was obstructed by three bars, designated as Lower Mud, Upper Mud, and Sand bars, over which but 1.2 feet could be carried at low tide. Aside from these obstructions the creek was amply wide and deep at low tide for vessels drawing up to 5 feet.

The original project for the improvement was adopted March 3, 1873, and provided for dredging channels 100 feet wide and 5 feet deep through these three bars at an estimated cost of \$18,000. This project was modified in 1879 to include a new channel through and a dike at Sand bar, and the dredging of a channel of the above dimensions through Occoquan bar at the head of navigation, increasing the estimated cost of the improvement to \$25,000. Four appropriations were made from 1873 to 1878, aggregating \$25,000, and in 1880 the improvement was regarded as completed.

The existing project for this stream was adopted September 19, 1890, and contemplates the dredging of channels 6 feet deep and 100 feet wide through the four bars (except the lower 2,000 feet of the Lower Mud bar, where the width is to be 150 feet), and the construction of dikes at Upper Mud, Sand, and Occoquan bars to maintain the depth obtained by dredging at an estimated cost of \$45,000. The project was extended by act of March 2, 1907, to include the dredging of a channel 150 feet wide and 6 feet deep through the Outer bar, over which the original ruling depth as 4.7 feet. The estimated cost of the project as modified is \$64,000.

The amount expended under the existing project to June 30, 1907, was \$27,411.83, of which \$3,814.68 was applied to maintenance subsequent to March 3, 1899. As a result of this expenditure, channels of the full projected dimensions have been dredged through all except the Outer bar and redredged where shoaling occurred, and 1,614 linear feet of dike has been constructed at Occoquan bar and Sand bar and repaired where injured by freshets and ice.

The entire project is now about one-half completed.

The work of maintenance undertaken during the fiscal year ended June 30, 1907, resulted in partly redredging the channel at Lower Mud bar.

The maximum draft that could be carried June 30, 1907, at mean low water over the shoalest part of the locality under improvement was 4.7 feet. The mean range of tide is about 2 feet. The town of Occoquan, 6 miles above the mouth, is the head of navigation.

The principal articles of commerce are railroad ties, building sand, piles, cord wood, lumber, grain, farm produce, coal, and flour. The receipts and shipments during 1906 amounted to about 26,000 tons and were estimated to be worth \$150,000.

The work done has been of great benefit to navigation in this creek, and it is understood that not only have shipments been facilitated, but freight rates have been materially reduced.

The additional work proposed is for the purpose of extension of benefits and maintenance of the work already done.

For reference to reports on examinations and surveys of this locality see pages 202 and 203 of the Annual Report of the Chief of Engineers for 1904 and page 237 of the Annual Report of the Chief of Engineers for 1906.

July 1, 1906, balance unexpended.....	\$5,956.59
Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	20,000.00
	<hr/> 25,956.59
June 30, 1907, amount expended during fiscal year, for maintenance of improvement .....	69.01
July 1, 1907, balance unexpended.....	25,887.58
July 1, 1907, outstanding liabilities.....	172.16
	<hr/> 25,715.42
July 1, 1907, amount covered by uncompleted contracts.....	5,100.00
Amount (estimated) required for completion of existing project.....	14,515.27

(c) *Carters Creek*.—Before improvement the entrance to Carters Creek, a tidal estuary of the Rappahannock River, was obstructed by a bar over which but 10½ feet could be carried at low tide, and navigation was rendered difficult near Gallyhook Point within the creek by the projection of this point into the channel, which was about 12 feet deep at low tide.

The original, which is also the existing, project for this improvement was adopted June 13, 1902, and provides for dredging a channel at the mouth to afford a navigable depth at low tide of 15 feet, with a width of 200 feet, including necessary widening at Crab Point, for the construction of a jetty for the protection of this channel, and for the dredging of a channel 12 feet deep and 100 feet wide at Gallyhook Point, at a total estimated cost of \$35,700.

The amount expended to June 30, 1907, was \$19,195.25, none of which was applied to maintenance.

As a result of this expenditure a channel 140 feet wide and 15 feet deep has been dredged through the bar at the mouth of the creek, and for a length of 600 feet this channel has been made 170 feet wide. The bar at the end of Crab Point has been dredged to a depth of 15 feet for a length of 400 feet over a maximum width of 100 feet. A channel of the full projected dimensions has been excavated at Gallyhook Point. A stone jetty 742 feet long has been constructed at the mouth of the creek. Harbor lines have been established. The entire project is now about two-thirds completed.

The maximum draft that could be carried on June 30, 1907, at mean low tide over the shoalest part of the outer bar was 15 feet, and at Gallyhook Point was 12 feet. The mean range of tide is 1.5 feet.

Irrington, about  $1\frac{1}{2}$  miles above the mouth of the creek, is the head of navigation for large steamers, while small sailing vessels drawing up to 5 feet can ascend about 1 mile farther.

The principal articles of commerce are fish, oysters, lumber, coal, guano, fish oil, wood, bricks, ice, farm produce, canned goods, and general merchandise. The receipts and shipments during 1906 amounted to about 46,000 tons and were estimated to be worth \$533,000. There is a good passenger trade in Carters Creek, which is also an important harbor of refuge.

The work done has been of considerable benefit to commerce, but as far as known has had no effect upon freight rates.

No further appropriation is necessary at present, as it is anticipated that the project can be completed with the funds now in hand.

For reference to the report upon an examination and survey of Carters Creek, see page 206 of the Annual Report of the Chief of Engineers for 1904.

July 1, 1906, balance unexpended.....	\$4, 610. 56
Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	10, 000. 00
	<hr/> 14, 610. 56
June 30, 1907, amount expended during fiscal year, for works of improvement.....	4, 217. 33
	<hr/>
July 1, 1907, balance unexpended.....	10, 393. 23
July 1, 1907, outstanding liabilities.....	62. 91
	<hr/>
July 1, 1907, balance available.....	10, 330. 32
	<hr/>
July 1, 1907, amount covered by uncompleted contracts.....	335. 22
Amount (estimated) required for completion of existing project....	6, 111. 52

#### CONSOLIDATED.

July 1, 1906, balance unexpended.....	\$19, 305. 27
Amount appropriated by river and harbor act approved March 2, 1907..	49, 000. 00
	<hr/> 68, 305. 27
June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$5, 517. 49
For maintenance of improvement.....	168. 71
	<hr/> 5, 686. 20
July 1, 1907, balance unexpended.....	62, 619. 07
July 1, 1907, outstanding liabilities.....	235. 07
	<hr/>
July 1, 1907, balance available.....	62, 384. 00
	<hr/>
July 1, 1907, amount covered by uncompleted contracts.....	10, 397. 88
Amount (estimated) required for completion of existing project....	126, 139. 60

(See Appendix K 5.)

6. *Nomini Creek, Virginia.*—Before improvement the navigation of Nomini Creek, a tributary of the Potomac, was obstructed by a bar at its mouth over which but 3 feet could be carried at low tide. Except for this bar a draft of 8 feet could be carried to Nomini Ferry, 4 miles above the mouth, and 5 feet could be carried 2 miles farther to the head of navigation.

The project for this improvement, adopted March 3, 1873, and modified in 1879, 1885, 1888, 1890, and 1897, provides for a channel

through the bar 150 feet wide and 9 feet deep, with jetties at the mouth and spur dikes inside White Point to check cross currents. The finally revised estimate of cost is \$105,000.

The amount expended to June 30, 1907, was \$74,045.33, of which \$4,008.71 was applied to maintenance subsequent to March 3, 1899.

As a result of this expenditure the channel has been dredged to a depth of 9 feet at low tide, with a width of 140 to 150 feet and redredged, and 1,200 linear feet of the east jetty has been constructed; 169 linear feet on the inshore end of the jetty is for shore protection purposes only. The entire project is now about two-thirds completed. The work of maintenance during the fiscal year ended June 30, 1907, resulted in partly protecting the sand on White Point against erosion.

The maximum draft that could be carried on June 30, 1907, at mean low tide over the shoalest part of the locality under improvement was 9 feet. The mean range of tide is 1.8 feet.

The principal articles of commerce are farm produce, lumber, cord wood, fertilizer, grain, railroad ties, oysters, and general merchandise. The receipts and shipments during 1906 amounted to about 23,700 tons and were estimated to be worth about \$550,000.

The work done has been of substantial benefit to navigation, and it is understood that freight rates have been considerably reduced and shipments much facilitated.

The additional work proposed is for the purpose of extension of benefits and for the preservation of the work already done.

A map of the locality may be found in the Annual Report of the Chief of Engineers for 1889.

For reference to a report on an examination and survey of Nomini Creek, see page 207 of the Annual Report of the Chief of Engineers for 1904.

Amount appropriated by river and harbor act approved March 2, 1907.	\$5,000.00
June 30, 1907, amount expended during fiscal year, for maintenance of improvement	45.33
July 1, 1907, balance unexpended	4,954.67
July 1, 1907, outstanding liabilities	5.14
July 1, 1907, balance available	4,949.53

Amount (estimated) required for completion of existing project..... 30,008.71

(See Appendix K 6.)

7. *Rappahannock River, Virginia.*—The lower portion of the Rappahannock River is generally a wide and deep body of water, having the characteristics of a tidal estuary rather than of a fluvial stream.

The obstructions to navigation before improvement was undertaken consisted of nine bars in the upper portion of the river between Tappahannock and Fredericksburg, over which the ruling depths were from 4 to 10½ feet. Seven of the bars were in the 12½ miles of river below Fredericksburg. Of these bars Fredericksburg bar, with a least depth of 4 feet, and Spottswood bar, 4 miles below Fredericksburg, with a least depth of 6 feet, caused the most delay to steamboats and vessels.

The project for this improvement, adopted March 3, 1871, as modified in 1879 and in 1905, provides for securing a channel 12 feet



deep and 100 feet wide between Fredericksburg and Port Royal and 12 feet deep and 200 feet wide between Port Royal and the mouth of the river, this result to be obtained by dredging and the construction of dikes, the latter being also designed to secure the excavated material deposited behind them. The total estimated cost of the revised project is \$363,228.86, increased by act of 1907 to \$393,633.12, exclusive of work properly chargeable to maintenance and estimated to cost \$38,500. The estimated annual cost of further maintenance is \$10,000.

The amount expended to June 30, 1907, was \$348,754.55, of which \$78,653.51 has been applied to maintenance since March 3, 1899. The sum of \$59,933.18 was expended prior to March 3, 1899, in dredging freshet deposits and in repairs to dikes.

The following sums have been obtained from other sources than appropriations: Damages recovered from contractor's sureties, \$1,000, and proceeds of sale of property, \$110; total \$1,110. This sum had not been expended at the close of the fiscal year.

The expenditure has resulted in the partial improvement of the seven bars between Fredericksburg and Port Royal by means of dredging and rock excavation, construction of dikes, and removal of wrecks which obstructed navigation. The entire project is now about six-tenths completed. The work of maintenance carried on during the fiscal year ended June 30, 1907, resulted in partially restoring previously dredged channels through Fredericksburg, Spottswood, and Castle Ferry bars, in repairing dikes at Pratts, Spottswood, and Castle Ferry bars, in removing a snag at Spottswood bar, and in protecting the fills against erosion by freshets.

The maximum draft that could be carried June 30, 1907, at mean low tide over the shoalest part of the locality under improvement was about 8½ feet. The mean range of tide is about 3 feet. Fredericksburg, 106 miles above the mouth, is the head of navigation.

This work is in progress under a continuing-contract appropriation, and the balance of the authorization remaining to be appropriated is \$90,000, to which sum should be added \$10,000 per annum for maintenance.

The principal articles of commerce are railroad ties, lumber, farm produce, grain, cord wood, fertilizers, flour, canned goods, coal, manufactures, and general merchandise. The receipts and shipments during 1906 amounted to about 364,000 tons and were estimated to be worth about \$6,150,000.

The work done has been of benefit to commerce, and it is understood that freight rates have been reduced.

It is proposed to apply the additional appropriation recommended toward dredging and dike construction and completion of the project.

The additional work proposed is for the purpose of extension of benefits and maintenance of the work already done.

At Fredericksburg bar new deposits of sand are formed by each recurring freshet, and shoaling is also constantly taking place, though less rapidly, at some of the lower bars. This explains the estimate of \$10,000 being required annually for maintenance.

Maps of this locality may be found in the Annual Reports of the Chief of Engineers for 1880, 1881, 1883, 1886, 1887, 1888, 1890, and 1906.

For reference to the report on an examination and survey of Rappahannock River, see page 208 of the Annual Report of the Chief of Engineers for 1904, and page 1110 of the Annual Report of the Chief of Engineers for 1906 for the report of the survey submitting the revised project.

July 1, 1906, balance unexpended.....	\$31,182.29
Amount appropriated by river and harbor act approved March 2, 1907.....	77,729.00
Amount received from sale of condemned property.....	110.00
Amount received from judgment recovered.....	1,000.00
	<hr/> 110,021.29
June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$15,446.03
For maintenance of improvement.....	6,990.81
	<hr/> 22,436.84
July 1, 1907, balance unexpended.....	87,584.45
July 1, 1907, outstanding liabilities.....	3,953.07
	<hr/> 83,631.38
July 1, 1907, balance available.....	83,631.38
July 1, 1907, amount covered by uncompleted contracts.....	3,706.48
Amount (estimated) required for completion of existing project.....	<sup>a</sup> 90,000.00
	<hr/>
{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907.....	75,000.00
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

(See Appendix K 7.)

8. *Urbana Creek, Virginia*.—Before the improvement of Urbana Creek, a tributary of the Rappahannock, a bar existed outside the mouth, over which but  $6\frac{1}{2}$  feet could be carried at low tide, and there was a shoal within the creek with a ruling depth of 7 feet.

The project for this improvement, adopted March 3, 1879, and modified in 1883, 1888, and 1897, provides for dredging a channel 150 feet wide and 10 feet deep through the outer and inner bars, with a turning basin of the same depth at the head, for a series of spur dikes at Bailey Point, and for a stone jetty to protect the cut through the outer bar. The final revised estimate of cost is \$70,000.

The amount expended to June 30, 1907, was \$33,606.56, of which \$5,850.65 has been applied to maintenance since March 3, 1899.

As a result of this expenditure there has been dredged a channel 10 feet deep and 150 feet wide through the outer bar, a channel 10 feet deep and 135 feet wide through the inner bar, and a small turning basin 10 feet deep at the steamboat wharf. These channels have been redredged where shoaling occurred.

Harbor lines have been established. The entire project is now about one-third completed.

The work of maintenance during the fiscal year consisted in laying out the modified lines of the Donaldson-Shultz wharf.

The maximum draft that could be carried on June 30, 1907, at mean low tide over the shoalest part of the locality under improvement was about 8.5 feet. The mean range of tide is 1.5 feet. The town of Urbana, at the mouth of the creek, is the head of navigation

<sup>a</sup> Plus \$10,000 per annum for maintenance.

for steamers and large vessels, while small vessels ascend the stream for a distance of 3 or 4 miles.

The principal articles of commerce are lumber, oysters, cord wood, excelsior, ice, coal, farm produce, canned goods, railroad ties, bricks, pickles, and general merchandise. The receipts and shipments during 1906 amounted to about 35,000 tons, and were estimated to be worth \$680,000.

The work done has been of benefit to commerce, and it is understood that freight rates have been reduced.

Work on this improvement was suspended between 1903 and 1907 pending the result of legal proceedings instituted by the Government to secure the removal of part of a wharf which projected into the proposed channel and which had been built in violation of the provisions of the act of March 3, 1899. The owners during the past year finally agreed to alter the wharf in accordance with the requirements of the War Department and have just begun the work.

The additional work proposed is partly for the extension of benefits and partly for the preservation of the work already done.

For reference to the reports on examinations and surveys of Urbana Creek, see page 210 of the Annual Report of the Chief of Engineers for 1904.

July 1, 1906, balance unexpended.....	\$9,899. 19
June 30, 1907, amount expended during fiscal year, for maintenance of improvement .....	5. 75
July 1, 1907, balance unexpended.....	9,893. 44
July 1, 1907, outstanding liabilities .....	15. 81
July 1, 1907, balance available .....	9,877. 63
Amount (estimated) required for completion of existing project.....	32,350. 65

(See Appendix K 8.)

9. *Harbor at Milford Haven, Virginia.*—Milford Haven is a tidal estuary of Chesapeake Bay, about 4 miles long and from one-half to 1 mile wide. The depth in the channel ranges from  $6\frac{1}{2}$  to 15 feet, and in the portion navigated by steamers is generally 9 feet or more. The haven has two entrances, one at the northwest end from Hills Bay, an arm of Piankatank River, and another at the southeast end, from Chesapeake Bay. Both entrances are obstructed by bars. The southeast entrance is exposed, and as the bar has a ruling depth of but 3 feet is seldom used. The bar which obstructed the northwest entrance had, before improvement, a ruling depth of 8 feet. A bar also existed within the haven between Cricket Hill and Callis wharves, with a ruling depth of about 8 feet.

The original, which is also the present, project for this improvement, was adopted March 3, 1899, and provides for dredging a channel 10 feet deep, with a minimum width of 200 feet, through the bar at the northwest entrance, at an estimated cost of \$12,500. The dredging of a similar channel through the inner bar was added to the project June 13, 1902, the total estimated cost being increased to \$17,500.

The amount expended to June 30, 1907, was \$17,974.13, none of which was applied to maintenance. Three thousand and thirty-two dollars and ninety-seven cents was recovered as judgment from a failing contractor.

As a result of this expenditure channels of the full projected dimensions have been dredged through both bars, which work has been of considerable benefit to navigation. The maximum draft that could be carried June 30, 1907, at mean low tide over the shoalest part of the locality under improvement was 10 feet. The mean range of tide is about 1.3 feet. The haven is navigable throughout its entire length by vessels drawing 6 feet, and Fitchett's wharf, about 3 miles above the northwest entrance, is the highest point reached by the large steamers.

The approved project is completed. The work remaining to be done is designed for maintenance and can be completed with the funds in hand.

The principal articles of commerce are oysters, fish, crabs, farm produce, fertilizers, piles, hay and feed stuff, lumber, building materials, flour, ice, and general merchandise. The receipts and shipments during 1906 amounted to about 14,700 tons, and were estimated to be worth about \$340,000.

The work done has been of considerable benefit to commerce and navigation. Freight rates have, however, been advanced.

The work contemplated in the project being completed, no further appropriation is asked.

For reference to reports on examinations and surveys of this locality see page 211 of the Annual Report of the Chief of Engineers for 1904.

July 1, 1906, balance unexpended.....	\$2, 578. 84
June 30, 1907, amount expended during fiscal year, for works of improvement.....	20. 00
July 1, 1907, balance unexpended.....	2, 558. 84
July 1, 1907, outstanding liabilities.....	48. 62
July 1, 1907, balance available.....	2, 510. 22

(See Appendix K 9.)

10. *James River, Virginia.*—The original condition of the James before its improvement by the General Government was begun in 1870 was as follows:

The ruling depth to the lower city line of Richmond was 7 feet below mean low water. This depth obtained on Rocketts reef, immediately below Richmond, and on Richmond bar, 2 miles below. Some 15 miles lower down, in Trents reach, was a shoal on which there was a depth of only 8 feet. This, however, ceased to be an obstruction in January, 1872, when the 5-mile reach in which it was situated was cut off by the opening of Dutch Gap Canal.

In addition to the above natural obstructions there were, in the 10 miles of river below Richmond, wrecks in the channel at Chaffins Bluff and Graveyard reach, and obstructions placed during the civil war at Warwick bar and Drewry Bluff, consisting at each locality of a military bridge, lines of stone cribs, and sunken vessels. In addition to all these obstructions, the channel between Richmond and Trents reach was in many places narrow and tortuous.

Between Trents reach and City Point, a distance of 18½ miles, the ruling depth was 13 feet, which obtained near Varina or Aikens Landing. Between City Point and the mouth of James River the ruling depth was 15 feet, existing at Harrisons bar and Goose Hill flats, then 43 and 76 miles, respectively, below Richmond.

It was contemplated in the original project, adopted in 1870, to secure a channel having a depth of 18 feet at high tide and a width of 180 feet. The amount expended prior to the adoption of the present project was \$735,000.

The project under which the improvement is now being carried on was adopted July 5, 1884. It provided for the formation by means of regulation works and excavation of a channel between the mouth of the river and the lower city line of Richmond, having a depth of 22 feet at mean low tide, and a width from the mouth to City Point of 400 feet; thence to Drewry Bluff of 300 feet, and thence to Richmond of 200 feet, at a total estimated cost of \$4,500,000.

The act of June 13, 1902, provided for extending the improvement from the lower city line of Richmond to the head of navigation at the docks, at an additional cost of \$724,943.15. The work proposed under this extension consists of excavating a channel about 3,300 feet long and 200 feet wide, with a depth of 22 feet at mean low water.

By act of March 3, 1905, the original project was further extended to include the excavation of a turning basin at Richmond, by increasing the width of the proposed improved channel to 400 feet for a length of 600 feet, the depth to be 22 feet, at a cost not to exceed \$150,000. This makes the total estimated cost of the improvement \$5,374,943.15.

The amount expended on the present project to June 30, 1907, was \$1,519,652.74, of which \$42,757, expended subsequent to March 3, 1899, was for maintenance. This item of maintenance includes the cost of dredging sand deposited in the channel by the river during the execution of the work in excess of the quantity originally estimated; also repairs to jetties.

The improvement of the river has been chiefly confined to the upper reaches, where the water was shoalest, and consequently where the greatest benefits to commerce would be obtained. The exceptions to this were the dredging of shoals at Harrisons bar, Swans Point, and Goose Hill flats to a depth of 18 feet.

The project is estimated to be about one-fourth completed.

The result of the work of improvement is a channel between Hampton Roads and the city wharf at Richmond, Va., having, with a few exceptions, a width of not less than 100 feet and a depth of 18 feet below mean low water. The exceptions are Rocklanding shoal, about 89 miles below Richmond, with a depth of 16.1 feet; Dancing Point shoal, about 60 miles below Richmond, with a ruling depth of 16½ feet, and Kingsland reach, about 10 miles below Richmond, with a ruling depth of 17 feet.

The work of maintenance during the fiscal year ended June 30, 1907, consisted in redredging the channel near Richmond and in deepening the channel in Kingsland reach by restoring jetties to produce scour.

The maximum draft that could be carried at low water on June 30, 1907, between the city wharf at Richmond and the mouth of the river was 16.1 feet.

The mean tidal range varies for different parts of the river, being approximately as follows: Two and one-half feet at Fort Monroe, 1.85 feet at Jamestown, 3 feet at City Point, 3½ feet at Dutch Gap, and 4 feet at Richmond.

The channel length of James River from Hampton Roads to the head of navigation at Richmond, Va., is 103.8 miles.

It is proposed to apply the available balance of funds to excavating part of the proposed turning basin at Richmond; to enlarging the channel at several points in the 5 miles below the James River and Kanawha Canal ship lock at Richmond; to making additions to the regulation works in this reach; to enlarging the channel and constructing and extending the regulation works in Kingsland reach, 10 miles below Richmond, and to dredging a channel through Rockland-ing shoal, the shoal nearest the river's mouth having a depth of less than 18 feet at low water.

The commerce of the river for the calendar year 1906 amounted to 241,317 tons at Richmond, Va., and 286,501 tons for points below, or an aggregate of 527,818 tons, a decrease of about 12.7 per cent from the tonnage of 1905. The value of the freight transported could not be ascertained.

The principal articles of commerce comprised lumber, coal, cord wood, groceries, fertilizer, and brick.

The improvement of the river has been beneficial in lowering railroad freight rates and in reducing the cost of river transportation.

Reports on examinations and surveys are found in Senate Executive Document No. 1, Thirty-third Congress, first session, Part II, 1853, page 389, and in Annual Reports of the Chief of Engineers of 1875, page 74; of 1878, page 459; of 1882, page 870; of 1887, page 873; of 1890, page 996; of 1896, page 1010; and of 1900, page 1754.

More extended information concerning the improvement is contained in Annual Reports of the Chief of Engineers of 1871, pages 603 to 605; of 1882, pages 870 to 887; and of 1900, pages 1757 to 1760.

Maps of James River are contained in the Annual Reports of the Chief of Engineers for 1876, 1900, and 1904, and in House Document No. 234, Fifty-sixth Congress, first session.

July 1, 1906, balance unexpended.....	\$272, 106. 30
Amount appropriated by river and harbor act approved March 2, 1907 .....	200, 000. 00
Amount received from sale of blueprints.....	. 67
	<hr/>
	472, 106. 97
June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$99, 170. 21
For maintenance of improvement.....	4, 757. 00
	<hr/>
	103, 927. 21
July 1, 1907, balance unexpended.....	368, 179. 76
July 1, 1907, outstanding liabilities.....	1, 523. 81
	<hr/>
July 1, 1907, balance available.....	366, 655. 95
July 1, 1907, amount covered by uncompleted contracts.....	156, 387. 18
Amount (estimated) required for completion of existing project..	3, 529, 868. 32

(See Appendix K 10.)

*11. Construction of piers, Hampton Roads, Jamestown Exposition.*—The original project was adopted by act of Congress, approved June 30, 1906, and provides for the construction, from plans to be furnished by the Jamestown Exposition Company and approved by

the Secretary of War, of two piers extending from the exposition grounds into the waters of Hampton Roads. They are to be connected at their outer ends by an arch sufficiently high to permit small craft to enter under it into a basin or harbor to be dredged to a sufficient depth to accommodate boats drawing not more than 10 feet at mean low tide, at a total cost not to exceed \$400,000.

This project was modified by act of Congress approved February 9, 1907, which provides, in addition to the work described above, for dredging a channel from deep water in Hampton Roads to the Government piers at the Jamestown Exposition, and for dredging in Bush Creek to accommodate the needs of the life-saving exhibit, at a cost not to exceed \$65,000.

Along the water front of the Jamestown Exposition there is a sand beach with a very gradual slope. The distance from the shore line out to the 10-foot contour is about 5,000 feet and the distance to the 12-foot contour about 7,000 feet. At a distance of about 11,000 feet there was an outer bar with a maximum depth of about 8 feet. The locality is sufficiently exposed to render an artificial harbor necessary if small boats are to land during bad weather. In Bush Creek the average depth over the area to be dredged was about zero at mean low water.

Plans and specifications were submitted by the Exposition Company and approved by the Secretary of War during September, 1906. The work was advertised and bids were opened October 22, 1906. The Scofield Company, of Philadelphia, Pa., were the only bidders, and their proposal was considerably in excess of the sum available. The same company later submitted a revised plan which was approved by the Jamestown Exposition Company and the Secretary of War and a contract was entered into with them on November 1, 1906, providing for the completion of the work in 180 days.

Actual construction of the piers has begun during December and practically no delays since that date have been due to lack of material. Except in the case of dredges an ample plant has been maintained. The work has been seriously delayed by the weather and by the labor conditions attendant upon exposition work. The work was so far completed by April 26, the opening day of the exposition, that the President was able to land there, and since that date the pier has been available for use of launches from naval vessels anchored in Hampton Roads. A detailed statement of the amount of work done is given in the report of the officer in charge. At the close of the fiscal year the piers as a whole were about 84 per cent completed.

A survey for the channel of approach and for the basin in Bush Creek was made during February. Dredging in the channel of approach was begun during March under supplemental contract with the Scofield Company, approved March 12, 1907. This dredging was seriously delayed by bad weather. At the close of the fiscal year a channel 185 feet wide and 11 feet deep had been dredged across the outer bar and a 7-foot channel had been dredged to the basin. At the close of the fiscal year the channel as a whole was about 68 per cent completed.

Proposals for doing the work in Bush Creek were opened during March and the only bid received was rejected on account of the high

price and the length of time for completion. The work was done by hiring dredges by the day and was completed on June 8.

Amount appropriated by act approved June 30, 1906.....	\$400,000.00
Amount appropriated by act approved February 9, 1907.....	65,000.00
	<hr/> 465,000.00
June 30, 1907, amount expended during fiscal year, for works of improvement.....	260,736.20
July 1, 1907, balance unexpended.....	204,263.80
July 1, 1907, outstanding liabilities.....	3,136.21
	<hr/> 201,127.59
July 1, 1907, balance available.....	
July 1, 1907, amount covered by uncompleted contracts.....	193,419.79

(See Appendix K 11.)

12. *Permanent landing pier at Jamestown Island, Virginia.*—By act of Congress approved June 30, 1906, \$15,000 was appropriated for erecting a permanent landing pier at Jamestown Island, Virginia, on the frontage owned by the Association for the Preservation of Virginia Antiquities, the necessary land for the pier to be donated to the United States by the association; or else the money was to be used for the purchase or lease of any suitable wharf at the island and a sufficient and proper amount of land adjacent thereto to give free access to the grounds of the association and the monument being erected by the Government.

The only work done so far has been the examination of the site and the preparation of plans for the wharf.

Amount appropriated by act approved June 30, 1906.....	\$15,000.00
June 30, 1907, amount expended during fiscal year, for works of improvement.....	338.56
July 1, 1907, balance unexpended.....	14,661.44

(See Appendix K 12.)

13. *Removing sunken vessels or craft obstructing or endangering navigation.*—(a) *Wreck of barge Laurel in Monroe Bay, Virginia.*—This wreck was reported as an obstruction to navigation on July 23, 1906. An allotment of \$20 was made July 31, 1906, for an examination of the wreck and the examination was completed a week later.

An allotment of \$500 was made August 14 for the removal of the wreck.

The wreck was blasted and removed from the channel by hired labor between September 25 and 29, 1906.

(b) *Wreck of dredge City of Richmond in James River at Richmond, Va.*—This wreck was reported as an obstruction to navigation January 5, 1907, and an examination promptly made.

An allotment of \$1,500 was made May 25, 1907, for removing the wreck and proposals for doing the work were opened on June 24, but were all found to be in excess of the allotment. An additional allotment will be asked for.

The total expenditure during the year on removal of wrecks was \$422.36.

(See Appendix K 13.)



## IMPROVEMENT OF NORFOLK HARBOR, VIRGINIA, AND ITS APPROACHES, AND OF CERTAIN WATERWAYS AND HARBORS IN SOUTHEASTERN VIRGINIA AND NORTHEASTERN NORTH CAROLINA.

This district was in the charge of Maj. E. Eveleth Winslow, Corps of Engineers, until November 2, 1906, and of Maj. Joseph E. Kuhn, Corps of Engineers, since that date. Division engineer, Lieut. Col. Dan C. Kingman, Corps of Engineers.

1. *Harbor at Norfolk and its approaches, Virginia.*—(a) *General improvement.*—In its original condition the main channel of this harbor was at mean low water navigable by vessels of 20 feet draft as far as the navy-yard, on the Southern Branch of the Elizabeth River, while in the Eastern Branch of this river there was a channel 15 feet in depth at mean low water as far as the Campostella bridge. These channels were of varying width.

The original project of improvement was adopted in 1878, revised in 1885, and amended in 1890, 1898, and 1905. It included the attainment of a channel from 500 to 700 feet wide and 25 feet deep at mean low water from Hampton Roads to the navy-yard, a branch channel 22 feet deep at the same stage of the tide to the Campostella bridge on the Eastern Branch, and, within the limits of the first-named channel, a channel 450 feet wide and 28 feet deep at mean low water from deep water in Hampton Roads to the navy-yard. There has also been included in the project the excavation of an anchorage at the mouth of the Western Branch, having an area of 56 acres and a depth of 25 feet at mean low water, and the dredging, to the depth of 28 feet at mean low water, of the area between the western edge of the main channel and a line 75 feet outside of the established pier-head line, along the railroad docks at Pinner Point. The cost of all this work was estimated at \$1,618,790.98.

The existing project of improvement is the original project modified from time to time as stated above.

To June 30, 1907, there had been expended on the existing project \$1,628,366.54, of which sum \$51,052.16 was for work of maintenance. The sum of \$10.71 has been derived from the sale of property and blueprints.

The expenditures incurred during the fiscal year were for surveys, running and maintenance of steamer *McGregor*, and office expenses.

On June 30, 1907, the project was about 97 per cent completed, the only work remaining to be done being a part of the dredging at Berkley flats and in the Eastern Branch between the Norfolk and Western and Campostella bridges.

On June 30, 1907, the main channel of the harbor was available at mean low water for vessels of 28 feet draft as far as the navy-yard, which is located about 10 miles from deep water in Hampton Roads. The Eastern Branch channel is available at mean low water for vessels drawing 22 feet as far as the Campostella bridge, about 11 miles from deep water in Hampton Roads. The normal range of the tide is 2.7 feet.

The Southern Branch of the Elizabeth River is navigable as far as the Albemarle and Chesapeake Canal locks, a distance of about 11 miles above the confluence of the Eastern and Southern branches of this river. The Eastern Branch is navigable for about 5 miles above

this confluence. From this confluence to deep water in Hampton Roads the distance by the main river is about 9 miles.

In recent years the commerce of the harbor and its approaches has increased materially due to the improvements, and for the calendar year 1906 it was reported at about 15,600,000 tons, with an estimated value of about \$628,000,000. The chief items of commerce are coal, cotton, fertilizers, lumber, and agricultural products.

It has not been found practicable to ascertain what effects, if any, the improvement has had upon freight rates. The improved channel has, however, greatly facilitated commerce, especially in the matter of coal shipments from the West Virginia fields, which find a deep-water outlet in Norfolk Harbor.

For more extended information and maps, see Reports of Chief of Engineers for 1880, page 815; 1885, page 1018; 1887, page 969, and 1893, page 1323. For reference to examinations and surveys, see Report of Chief of Engineers for 1906, page 238.

July 1, 1906, balance unexpended.....	\$9, 514. 82
Amount appropriated by river and harbor act approved March 2, 1907..	37, 825. 00
Received on account of sales.....	9. 10
	<hr/>
	47, 348. 92
June 30, 1907, amount expended during fiscal year, for works of improvement.....	5, 863. 33
	<hr/>
July 1, 1907, balance unexpended.....	41, 485. 59

(b) *Hospital Point*.—The land of this point is the property of the United States, and is a part of the grounds used by the Navy Department as a site for a hospital. The main channel of Norfolk Harbor passes in front of and close to this point.

The project for this work, adopted in 1902, required the cutting off of 450 feet of the point, the construction of a sea wall and wharf, and the dredging of the area on both sides of the old point. The depth to be secured in the dredging was to be the same as that of the harbor—25 feet at mean low water. The estimated cost of the work was \$193,957, all of which has been appropriated.

On June 30, 1907, the expenditures had amounted to \$187,564.61, and had resulted in the completion of the project. The expenditures incurred during the fiscal year were for surveys, running and maintenance of steamer *McGregor*, and office expenses. It is proposed to utilize the available balance of the appropriation in maintaining the improvement.

The statements in the previous section of this report regarding the character and volume of the commerce affected by the improvement of Norfolk Harbor, and as to the tidal range, state of navigability of the harbor, and the effect of the improvement on freight rates apply to this section also.

A report upon an examination of this work will be found at page 964, Annual Report of the Chief of Engineers for 1889; and in the report for 1897, page 1335 et seq., full details of the project, with maps explanatory thereof, are given.

July 1, 1906, balance unexpended.....	\$7, 809. 34
June 30, 1907, amount expended during fiscal year, for works of improvement.....	1, 416. 95
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July 1, 1907, balance unexpended.....	6, 392. 39

(c) *Thirty-foot channel*.—As noted in section (a) above, the existing ship channel affords a 28-foot navigation, 450 feet wide, from Hampton Roads to the junction of the Southern and Eastern branches.

Under a project adopted March 2, 1907, the existing ship channel is to be deepened to 30 feet and to be given a width of 600 feet from Hampton Roads to Lambert Point and 800 feet from Lambert Point to the junction of the Eastern and Southern branches of the Elizabeth River. This project also includes the removal of the shoals at the mouth of the Eastern Branch to a depth of 25 feet and a width of 500 feet. The estimated cost of the project is \$1,132,000.

The expenditures for the fiscal year ending June 30, 1907, have amounted to \$982.84.

This project is in progress under a continuing-contract appropriation, for which the sum of \$850,000 still remains to be appropriated.

No work has yet been accomplished under the project, operations having been confined to the preparation of specifications and to inviting proposals. The new ship channel will have a length of about 9 miles.

The statements contained in section (a) above, regarding the character and volume of commerce, tidal range, and state of navigability of the channel apply to this section also.

The amount estimated as a profitable expenditure for the fiscal year ending June 30, 1909, will be applied to continuing the work of improvement for the purpose of extending its benefits.

Reports, with maps, upon examinations of this improvement will be found in House Documents Nos. 373 and 381, Fifty-ninth Congress, first session.

Amount appropriated by river and harbor act approved March 2, 1907.	\$282, 000. 00
June 30, 1907, amount expended during fiscal year, for works of improvement	982. 84

July 1, 1907, balance unexpended	281, 017. 16
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Amount (estimated) required for completion of existing project	850, 000. 00
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{	Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907	350, 000. 00
	Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

(See Appendix L 1.)

2. *Western Branch of Elizabeth River, Virginia*.—The channel of the river, when the project for improvement was adopted, was 12 feet deep at mean low water and from 50 to 300 feet wide.

The project adopted in 1896 provided for obtaining, by dredging, a channel 200 feet wide and 20 feet deep at mean low water for a distance of about 1 mile from deep water in Norfolk Harbor. The estimated cost was \$45,000, all of which has been appropriated.

Up to June 30, 1907, the sum of \$44,671.65 has been expended on this improvement, the result being the completion of the project. No expenditures were made during the fiscal year.

It is proposed to utilize the available balance in maintaining the improvement.

A draft of 20 feet at mean low water can be carried in the improved channel. The average rise and fall of the tide is 2.7 feet.

This stream is navigable for small sailboats to farms situated about 9 miles from its mouth.

The commerce in the main consists of manufactured lumber, ore, and farm products, and had increased from 211,653 tons in 1896 to 1,383,105 tons in 1901.

For the calendar year 1906 it is reported to have amounted to 4,225,179 tons, valued at \$36,589,005.

The channel is ample in depth, but it may be necessary to widen it in the near future to provide anchorage space, and thus relieve the overcrowded condition of the area in Norfolk Harbor designated for that purpose.

It has not been found possible to ascertain what effect, if any, the improvement has had upon freight rates.

For reference to list of reports on examinations of this stream, see Report of the Chief of Engineers for 1906, page 240.

July 1, 1906, balance unexpended.....	\$328. 35
July 1, 1907, balance unexpended.....	328. 35

(See Appendix L 2.)

3. *Hampton Roads, Virginia.*—Before improvement, vessels of more than 25 feet draft could not reach Newport News on account of the shoal in Hampton Roads, known locally as Middle Ground bar.

Under an item in the act of June 13, 1902, provision was made for dredging a channel through the Middle Ground bar 500 feet wide and 30 feet deep at mean low water. The estimated cost of the work was \$225,000.

Up to June 30, 1907, \$224,943.51 had been expended on the work and the project was completed. The expenditures for the fiscal year were applied to surveying and office expenses.

On June 30, 1907, vessels of 30 feet draft could navigate the channel safely, but there are signs of deterioration in the channel and dredging will be required to maintain the project depth and width. The average tidal range is 2.5 feet.

The head of navigation via this channel is at Richmond, Va., on the James River, a distance of about 105 miles up the river.

The amount of commerce when the improvement was undertaken in 1902 amounted to 2,663,669 tons. For the calendar year 1906 it is reported to have amounted to 5,564,086 tons, valued at \$453,370,363. The bulk of the tonnage is in coal.

It is proposed to expend the available balance in maintaining the project depth and width of channel for the purpose of keeping the improvement available.

For reference as to reports on examinations and surveys see Report of the Chief of Engineers for 1906, page 240.

July 1, 1906, balance unexpended.....	\$287. 00
Amount appropriated by river and harbor act approved March 2, 1907.....	12, 500. 00

12, 787. 00

June 30, 1907, amount expended during fiscal year, for works of improvement.....	230. 51
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July 1, 1907, balance unexpended.....	12, 556. 49
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(See Appendix L 3.)

4. *Nansemond River, Virginia.*—The original channel of this stream permitted it to be navigated at mean low water by vessels drawing not more than 5 feet. The depth was increased to 8 feet at the same stage of tide under appropriations made between 1873 and 1878 at a cost of \$37,000.

The project under which the work has been carried on until recently was adopted August 11, 1888, and called for a channel 100 feet wide from Suffolk, the head of navigation, to the Western Branch, while from the latter place to Town Point its width was to vary from 200 to 400 feet. The depth to be obtained throughout was 12 feet at mean low water. This improvement was estimated to cost \$152,500.

At present it is contemplated to provide a channel only 80 feet wide and 12 feet deep at mean low water between Suffolk and Town Point, which is now deemed ample for the commerce of the stream.

Up to June 30, 1907, the expenditures under the project of 1888 and its modification have amounted to \$49,946.61, of which amount \$9,269.50 has been applied to maintenance. The channel between Suffolk and the Western Branch has been dredged to 80 feet in width and 12 feet in depth at mean low water, and a turning basin has been excavated at the former place. The project is about 67 per cent completed.

At the close of the fiscal year a boat drawing 11 feet at mean low water could reach Suffolk, the head of navigation, 18 miles above the mouth of the river. The tidal variations are about 3 feet at Town Point and 3.8 feet at Suffolk.

The commerce of the stream consists principally of lumber, agricultural products, and merchandise. In 1890 it is reported to have reached about 220,000 tons. For the calendar year 1906 it is reported to have amounted to 91,063 tons, valued at \$4,239,518.

It has not been found possible to ascertain what effect, if any, the improvement has had upon freight rates.

For reference to list of reports of examinations and surveys see Report of Chief of Engineers for 1906, page 241.

July 1, 1906, balance unexpended.....	\$53. 39
Amount appropriated by river and harbor act approved March 2, 1907.	5, 000. 00

July 1, 1907, balance unexpended.....	5, 053. 39
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Amount (estimated) required for completion of existing project.....	7, 769. 50
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(See Appendix L 4.)

5. *Pagan River, Virginia.*—Originally the shoals in this stream limited the draft of vessels to 6½ feet at mean low water. Under a project adopted in 1880 the sum of \$10,000 was expended in dredging a channel 60 feet wide and 8 feet deep at mean low water through three shoals between the mouth and Smithfield, Va.

The project upon which was based the appropriation of \$10,870 in the act of June 13, 1902, provided for obtaining a channel from Smithfield to the mouth of the river 80 feet wide and 8 feet deep at mean low water. The estimated cost was \$28,870. This project was modified by the act of March 3, 1905, which authorized the expenditure of the balance remaining of the appropriation of 1902 in securing a channel not less than 40 feet wide and of such depth as might be

obtained without exceeding said balance. In the project submitted under the above-cited provision of law it was stated that the unexpended balance would provide such a channel 10 feet in depth at mean low water.

Up to June 30, 1907, the expenditures had amounted to \$10,671.01, and the project has been completed.

There is now a navigable channel 40 feet wide and 10 feet in depth at mean low water from the mouth of the river for a distance of about 9 miles to Smithfield, the head of navigation. The average range of the tide is 2.6 feet.

The commerce is handled by numerous small schooners and sloops and two regular steamers, and consists largely of peanuts and oysters.

The commerce of this stream has averaged about 100,000 tons a year, but has varied considerably from year to year according to whether conditions have or have not been favorable to the production of peanuts and oysters. For the calendar year 1906 it is reported to have amounted to 87,505 tons, valued at \$15,130,492.

It has not been found possible to ascertain what effect, if any, the improvement has had upon freight rates.

Reports upon examinations and surveys of this river will be found in the Annual Reports of the Chief of Engineers for 1875, Part 2, page 156, and for 1901, page 1174.

July 1, 1906, balance unexpended.....	\$2,366.81
June 30, 1907, amount expended during fiscal year, for works of improvement.....	2,167.82

July 1, 1907, balance unexpended.....	198.99
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(See Appendix L 5.)

6. *Appomattox River, Virginia.*—(a) *Maintenance.*—The original channel in this river was narrow and tortuous, and numerous shoals prevented vessels drawing more than 6½ feet from navigating it at mean high water.

The original project, which is also the existing project, was adopted in 1871 and revised in 1893. The project as revised covers the attainment and maintenance of a channel 80 feet wide and 12 feet deep at mean high water between Point of Rocks and Petersburg. The cost of providing this channel was estimated at \$471,920 and its maintenance at \$10,000 annually.

On June 30, 1907, the sum of \$423,830 had been expended toward the improvement and the sum of \$49,234.97 for maintenance. The expenditures during the fiscal year ending June 30, 1907, were applied to maintenance and resulted in the partial restoration of the channel previously obtained. The project is about 85 per cent completed.

At the present time the channel of the river is available at high water for vessels of about 9 feet draft, the normal range of the tide being about 2.6 feet. The head of navigation is Petersburg, Va., about 11 miles from the mouth of the river.

The commerce consists of lumber and miscellaneous products. In 1890 it amounted to about 20,000 tons. It gradually increased until in 1900 and 1901 it amounted to about 150,000 tons. Since then it has decreased, and for the calendar year 1906 it is reported to have amounted to 30,438 tons, valued at \$510,924.

It is proposed to expend the balance now available in removing material brought down by freshets and deposited in the navigable channel of the river and toward the completion of the project. This work is required by the interest of commerce in order to render the navigable channel available and will be undertaken immediately upon the completion of the work now in progress at Petersburg, which will be probably completed before July 1, 1908, and which has for its object to prevent the deposit of sediment in the navigable channel.

An examination of this stream was made in 1852, to which reference is made in the Annual Report of the Chief of Engineers for 1870, page 68. A survey was made in 1870 and the report published in the Annual Report of the Chief of Engineers for that year, commencing at page 68.

July 1, 1906, balance unexpended.....	\$10,004.70
Amount appropriated by river and harbor act approved March 2, 1907 .....	50,000.00
	<hr/>
	60,004.70
June 30, 1907, amount expended during fiscal year, for maintenance of improvement .....	10,071.37
	<hr/>
July 1, 1907, balance unexpended.....	49,933.33

(b) *At Petersburg.*—The project for the work contemplated is not to provide a navigable channel, but to excavate a new channel into which to deflect the river, and thus overcome the trouble experienced by the deposit of sediment in the navigable channel of the river in the neighborhood of Petersburg.

The project for this work, which was adopted June 13, 1902, contemplates the excavation to mean low water of a cut from 200 to 300 feet wide and  $2\frac{1}{2}$  miles long and the diversion of the river into the said cut by means of a dam built across the present channel at the head of the harbor of Petersburg, and includes the construction of bridges for the highways and railway crossing the new channel and other incidental work. The estimate for the work is \$200,000, which amount has been provided.

At the close of the fiscal year 1907 the sum of \$102,042.08 had been expended, all of the land needed has been purchased, the highway bridge has been built, the new cut has been partially excavated, and one abutment and four piers of the railway bridge put in. The expenditures during the fiscal year were applied to payment for work done under contract. The project is about 60 per cent completed.

It has not been found possible to ascertain what effect, if any, the improvement has had upon freight rates.

The balance of funds will be applied to completing the work under the adopted project.

The commerce to be affected by the improvement contemplated is the same as that mentioned in the preceding section, and all general statements made therein apply equally well to this section.

A report upon an examination and survey will be found in the Annual Report of the Chief of Engineers for 1882, page 907. Another report, with a map, will be found in the Report of the Chief of Engineers for 1889, page 957. Other reports will be found in the Annual Reports of the Chief of Engineers for 1893, page 1345, and for 1901, page 1467.

July 1, 1906, balance unexpended.....	\$133, 719. 38
June 30, 1907, amount expended during fiscal year, for works of improvement .....	35, 761. 46
July 1, 1907, balance unexpended.....	97, 957. 92
July 1, 1907, outstanding liabilities .....	265. 00
July 1, 1907, balance available.....	97, 692. 92
July 1, 1907, amount covered by uncompleted contracts.....	72, 427. 15
(See Appendix L 6.)	

7. *Harbor at Cape Charles City, Va.*—The harbor proper is landlocked and covers an area of 10 acres, and it and the exposed channels leading thereto had, before the beginning of the work, a depth of 12 feet at mean low water.

The project was adopted in 1890 and requires the dredging of a channel through Cherrystone Inlet and bar 200 feet wide and 16 feet deep at mean low water, the dredging of an entrance channel 100 feet wide of the same depth, and dredging over the entire area of the protected and inclosed harbor to a depth of 14 feet at mean low water. Jetties of stone were to be constructed for the protection of the channel leading into the basin. This work was estimated to cost \$142,340.

The expenditures to June 30, 1907, amounted to \$83,762.43, and resulted in the dredging and redredging of one-half of the inner harbor to the proper depth and the excavation of channels of the required dimensions through the inlet, bar, and the entrance to the basin and the construction of 875 feet of the north jetty and 232 feet of the south jetty. The north jetty is 1,625 feet in length, but 750 feet of this was built without expense to the United States. The project is about 60 per cent completed.

The expenditures for the year were applied to dredging and contingencies.

On June 30, 1907, a vessel drawing 12 feet could enter the harbor at mean low water. The docks within the landlocked harbor are about 3 miles from the 16-foot contour in Chesapeake Bay at Cherrystone bar. The mean range of the tide is about 2.5 feet.

The commerce consists mainly of miscellaneous freight, agricultural products, fertilizer, and some oysters and fish. At the beginning of the improvement the annual commerce was about 400,000 tons. For the calendar year 1906 it is reported to have amounted to 1,723,635 tons, value not known. It has not been found possible to ascertain what effect, if any, the improvement has had upon freight rates.

For more extended information, see Annual Report of the Chief of Engineers for 1890, page 975.

July 1, 1906, balance unexpended.....	\$16, 899. 88
Amount appropriated by river and harbor act approved March 2, 1907.....	25, 000. 00
	41, 899. 88
June 30, 1907, amount expended during fiscal year, for works of improvement .....	662. 31
July 1, 1907, balance unexpended.....	41, 237. 57
Amount (estimated) required for completion of existing project.....	17, 340. 00

(See Appendix L 7.)



8. *Waterway from Norfolk, Va., to the sounds of North Carolina.*—This waterway extends from Norfolk, Va., via the Southern Branch of the Elizabeth River to Deep Creek, thence through the Dismal Swamp Canal to South Mills, N. C., and from the latter point through Turners Cut to the Pasquotank River, to Albemarle Sound, and thence to Pamlico Sound by Croatan Sound.

The draft which could be carried through this waterway at the time of the adoption of the project for improvement was limited to 2½ feet at mean low water, owing to the deterioration of the Dismal Swamp Canal, which originally had had a depth of about 6 feet.

The project, adopted March 3, 1899, provides for the dredging of channels in Deep Creek, Turners Cut, through a shoal in the Pasquotank River near Ship Yard bar, and through a bar in Croatan Sound near Croatan light. All these channels, except the last named, were to be 100 feet wide and 10 feet deep at mean low water. The Croatan channel was to be 200 feet wide and 12 feet deep at mean low water. For the protection of these channels sheet piling was to be driven where necessary. The estimated cost of this work was \$274,310.

Up to June 30, 1907, the sum of \$251,196.46 had been expended on the project and \$6,630.32 on its maintenance. The project has been completed, and the additional work required is for maintenance. The expenditures during the fiscal year were applied to redredging a portion of the channel in Deep Creek.

On June 30, 1907, vessels drawing 10 feet of water can at mean low water navigate from Norfolk, Va., through all sections of the route which have been improved by the United States. The canal, which extends from Deep Creek to South Mills, is maintained at the expense of a private corporation, which tries to keep it available for vessels of 10 feet draft, but on June 30, 1906, the limiting depth for the entire route was only 9 feet, owing to the existence of shoal places in the canal. Deep Creek is the only tidal portion of the improvement, and there the rise and fall averages 3 feet. In the other sections the water level changes according to the direction and velocity of the wind. The route is about 67 miles in length.

The commerce carried over this waterway is increasing slowly. It is stated in the calendar year 1906 to have amounted to 388,488 tons, valued at \$3,644,646. The main items of commerce are coal, fertilizer, timber, and farm products.

It has not been found possible to ascertain what effect, if any, the improvement has had upon freight rates.

For list of reports of examinations and surveys, see Annual Report of the Chief of Engineers for 1906, page 246.

July 1, 1906, balance unexpended.....	\$4, 415. 71
Amount appropriated by river and harbor act approved March 2, 1907.....	5, 000. 00

	9, 415. 71
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	4, 372. 49

July 1, 1907, balance unexpended.....	5, 043. 22
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(See Appendix L 8.)

9. *Inland water route from Norfolk, Va., to Albemarle Sound, North Carolina, through Currituck Sound.*—This route extends from

Norfolk, Va., to Albemarle Sound, via the Southern Branch of the Elizabeth River, Albemarle and Chesapeake Canal, North Landing River, Currituck Sound, Coanjock Bay, North Carolina Cut, and North River. The canal and cut mentioned are now controlled by a private corporation.

This route had originally a good 5-foot mean low-water channel, but navigation was obstructed by snags, sunken logs, and overhanging trees. Sharp bends added to the other difficulties of navigation.

Until the act of September 19, 1890, the work of improvement was carried on under several separate projects, upon which a total of \$240,169.69 had been expended. By that act all these projects were consolidated.

The present project, adopted September 19, 1890, provides for obtaining a channel 80 feet wide and 9 feet deep at mean low water through the whole extent of the waterway to be improved by the United States, at an estimated cost of \$306,667.08, including the previous expenditures above mentioned. The project is considered as complete, the additional work required being for maintenance. Since September 19, 1890, and up to June 30, 1907, the sum of \$61,987.64 has been expended upon the improvement, and \$30,322.70 upon maintenance. The expenditures during the fiscal year were applied to maintenance. The work consisted in keeping the waterway clear of sunken logs and stumps and in redredging a channel in the Southern Branch of the Elizabeth River.

The channels through the various portions of the route are now from 60 to 80 feet wide and have a depth of 9 feet at mean low water. The draft of vessels which can pass through the route at mean low water on June 30, 1907, is 9 feet. The route is about 67 miles long.

There is no lunar tide in any portion of the route, except in the Southern Branch of the Elizabeth River, where the average rise and fall is 2.7 feet. In the other sections the water level varies according to the velocity and direction of the wind, for which an allowance of 0.5 foot is made, but severe storms may cause an elevation or depression of 2 feet or more.

The commerce has varied considerably since the route was opened to navigation. The highest reported was for the calendar year 1890, when it amounted to 403,111 tons. Since that time it has decreased considerably, and for the calendar year 1906 it amounted to 100,000 tons, valued at \$2,250,000. The principal items of shipment consist of coal, fertilizer, and timber products.

The gradual decrease in the commerce of the route is due to the depletion of the forests and the consequent decrease in timber shipments.

It has not been found possible to ascertain what effect, if any, the improvement has had upon freight rates.

Considerable difficulty is experienced in keeping this waterway free from obstructions by logs dropped from rafts due to the improper construction of the rafts, and, in the absence of any adequate laws permitting the Engineer Department to control the construction of rafts, it has been found impossible to prevent the frequent occurrence of these obstructions.

For references as to examinations and surveys, see Annual Report of the Chief of Engineers for 1906, page 247.

July 1, 1906, balance unexpended	\$8,969.96
Amount appropriated by river and harbor act approved March 2, 1907	3,000.00
Received on account of sales	39.25

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12,009.21

June 30, 1907, amount expended during fiscal year, for maintenance of improvement	8,775.30
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July 1, 1907, balance unexpended	3,233.91
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(See Appendix L 9.)

10. *Perquimans River, North Carolina.*—Before work was begun navigation was obstructed by numerous stumps just below the town of Hertford, N. C., which limited the draft of vessels to 7 feet.

The first appropriation for the Perquimans River was made in 1876, and was based on a project to provide a channel 200 feet wide with a depth of 9½ feet at mean low water through a stumpy reach near Hertford, N. C., and the amount provided (\$2,500) was expended in obtaining said channel, which was completed in 1877.

The existing project, adopted by Congress March 3, 1905, was to provide a channel 200 feet wide and 9 feet deep at mean low water through the stumpy reach about 800 feet below Hertford, N. C., at an estimated cost of \$11,250.

To June 30, 1907, \$11,168.06 had been expended, and all the work contemplated has been completed.

On June 30, 1907, vessels drawing 9 feet can, at mean low water, reach the town of Hertford.

There is no lunar tide in the river, the level of the surface of the water varying according to the direction and velocity of the wind. The average difference in elevation is about one-half foot, but storms may cause a difference of as much as 2 feet or more. The head of navigation is at Newby's bridge, about 26 miles from the mouth of the river.

An estimate in 1902 placed the commerce at about 36,000 tons, and for the calendar year 1906 it is estimated to have amounted to 108,570 tons, valued at \$622,250. The principal items of freight transported were lumber and logs.

It has not been found possible to ascertain what effect, if any, the improvement has had upon freight rates.

July 1, 1906, balance unexpended	\$81.94
----------------------------------	---------

July 1, 1907, balance unexpended	81.94
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(See Appendix L 10.)

11. *Blackwater River, Virginia.*—In its original condition this stream afforded a natural channel of 7 feet depth, but navigation was difficult owing to the existence of obstructions and sharp bends.

Between 1878 and 1882 Congress appropriated a total of \$14,000 for the improvement of the stream, to consist of the removal of logs, snags, overhanging trees, and the removal of sharp bends. Operations ceased in 1884, since which time no work has been done upon the river.

The existing project was adopted March 2, 1907, and provides for the clearing of the stream of the existing obstructions so as to afford a condition of easy navigation. The estimated cost of the project is \$8,000, all of which has been appropriated.

No expenditures have yet been made under the existing project.

On June 30, 1907, vessels drawing 7 feet can navigate the river, but navigation is seriously endangered by the existence of numerous obstructions which have formed since the cessation of the earlier operations in 1884. The river is a tideless stream, and the only fluctuations in the water level are those due to freshets, which usually do not exceed 3 to 4 feet. The river is navigable from the railroad bridge at Franklin, Va., to its mouth, a distance of about 13 miles.

During the calendar year 1906, the commerce amounted to 5,200 tons, valued at \$832,000. The principal items consisted of agricultural products, timber, and fertilizer.

It is at present impracticable to state what effect, if any, will be made by the improvement upon freight rates.

For more extended information see Report of the Chief of Engineers for 1875, Part 2, page 161, and report of an examination printed in House Document No. 177, Fifty-ninth Congress, first session.

Amount appropriated by river and harbor act approved March 2, 1907.	\$8,000.00
July 1, 1907, balance unexpended.....	8,000.00

(See Appendix L 11.)

*12. Meherrin River, North Carolina.*—In its original condition this stream afforded a navigable channel about 80 feet wide and 7 feet deep from its mouth to the town of Murfreesboro, N. C. The channel was tortuous and badly obstructed by logs, overhanging trees, and a few shoals.

In the year 1882 Congress appropriated \$5,000 toward the improvement of the river, the improvement to consist in the removal of the obstructions to navigation, and operations were carried on from time to time in the years 1883 to 1886, inclusive. The total expenditure amounted to \$4,584.53.

The existing project was adopted by Congress March 2, 1907. It provides for the removal of existing obstructions in the nature of sunken logs, overhanging trees, and a few shoals, so as to render navigation easy. The estimated cost of the project is \$6,000, all of which has been appropriated. No expenditures have yet been made for work under the existing project.

On June 30, 1907, the maximum draft that could be carried with safety was 7 feet. The river is a tideless stream, but freshets cause variations in the water level of 3 to 4 feet. The head of navigation is at Murfreesboro, 11 miles above the mouth of the river.

During the calendar year 1906 the commerce of the river aggregated 8,900 tons valued at \$85,750. The principal items of shipment are timber products and general merchandise.

It is impracticable at this time to state what effect, if any, the improvement will have on freight rates.

For more extended information see Report of the Chief of Engineers for 1882, page 1114, and report of examination printed in House Document No. 137, Fifty-ninth Congress, first session.

Amount appropriated by river and harbor act approved March 2, 1907.	\$6,000.00
July 1, 1907, balance unexpended.....	6,000.00

(See Appendix L 12.)

*13. Roanoke River, North Carolina.*—Originally the navigable channel to Indian Highland bar, 67 miles above the mouth, was 10 feet deep at mean low water, and thence to the town of Weldon, which is

129 miles from the mouth, the minimum depth was  $2\frac{1}{2}$  feet at the same stage.

The project, adopted in 1871, contemplates a channel with a least width of 50 feet from Hamilton to Weldon, 5 feet deep at mean low water, and the removal in the lower portion of the river, below the former point, of such obstructions as may be necessary to accommodate vessels navigating North Carolina sounds. The estimated cost of the work was \$269,000.

The expenditures to June 30, 1907, amounted to \$236,684.44, of which amount \$7,994.21 has been expended in maintenance and \$1,351.75 was received from sales. The project is about 80 per cent completed. The channel obstructions have been removed, and a channel depth of 4 feet at mean low water over the projected width has been provided between Hamilton and Weldon. On June 30, 1907, vessels drawing 10 feet can go as far as Hamilton, and beyond that point to within a short distance of Weldon 4 feet can be carried at mean low water. The upper river is subject to heavy freshets, which cause the only variation in the level of the water surface. Weldon, situated about 129 miles from the mouth, is the head of navigation.

The commerce has varied considerably since the improvement was undertaken, the maximum amount of freight transported having been in 1891, when it was 376,181 tons. Since then it has decreased, and for the calendar year 1906 it was reported at 88,508 tons, valued at \$1,032,400. The principal item of shipment is timber.

It has not been found possible to ascertain what effect, if any, the improvement has had upon freight rates.

For reference to reports of examinations and surveys, see Report of the Chief of Engineers for 1906, page 249.

July 1, 1906, balance unexpended-----	\$5, 162. 61
Amount appropriated by river and harbor act approved March 2, 1907--	3, 000. 00
	<hr/> 8, 162. 61
June 30, 1907, amount expended during fiscal year, for maintenance of improvement-----	2, 495. 30
	<hr/> 5, 667. 31
July 1, 1907, balance unexpended-----	5, 667. 31
Amount (estimated) required for completion of existing project----	38, 994. 21
(See Appendix L 13.)	

14. *Removing sunken vessels or craft obstructing or endangering navigation.*—(a) *Wreck of steamer "Norfolk-on-the-Roads."*—The hull of this steamer obstructed the navigation of Back Creek, Virginia, and its removal, except a few large timbers which were embedded in the bottom of the creek, was effected in May, 1906, at a cost of \$1,500. The remaining timbers were removed during the month of July, 1906, at a cost of \$1,000.

(b) *Wreck of schooner "Georgia F. Golden."*—This vessel sank in Norfolk Harbor. Its removal was authorized July 10, 1906, and the work was accomplished at a cost of \$857.66, during July, 1906.

(c) *Wreck of barge "John R. Zimmerman."*—This barge sank off Sewell Point, Hampton Roads, Virginia. Its removal was authorized December 7, 1906, and the work was accomplished at a cost of \$4,850, during December, 1906.

(d) *Wreck of schooner "Three Sisters."*—This vessel sank in Hampton Creek, Virginia. Its removal was authorized May 3, 1907, and was accomplished during May, 1907, at a cost of \$500.

(e) *Wreck of barge (name unknown).*—This barge sank in Smith Creek, an arm of Norfolk Harbor. Its removal was authorized June 10, 1907. The wreck will be raised early in the fiscal year 1908.

(See Appendix L 14.)

EXAMINATION AND SURVEY OF INLAND WATERWAY FROM NORFOLK, VA.,  
TO BEAUFORT, N. C., MADE IN COMPLIANCE WITH RIVER AND HARBOR  
ACT APPROVED MARCH 3, 1905.

Report dated May 9, 1906, by a Board of Engineers on examination and survey required by the river and harbor act approved March 3, 1905, of inland waterway from Norfolk, Va., to Beaufort Inlet, North Carolina, with a view to obtaining a channel of a depth of 10 and 12 feet, respectively, was duly submitted and was reviewed by the Board of Engineers for Rivers and Harbors pursuant to law. It was transmitted to Congress and printed in House Document No. 84, Fifty-ninth Congress, second session. Alternative plans are presented for improvement at an estimated cost, respectively, of \$2,900,425, plus the cost of the Albemarle and Chesapeake Canal, and \$3,378,055, with estimates for maintenance amounting to \$290,000 for first cost of plant and \$72,000 annually thereafter for operation.

IMPROVEMENT OF CERTAIN RIVERS AND HARBORS IN NORTH  
CAROLINA.

This district was in the charge of Capt. R. P. Johnston, Corps of Engineers, to September 4, 1906; in the temporary charge of Maj. E. Eveleth Winslow, Corps of Engineers, from September 4 to November 2, 1906, and of Maj. Joseph E. Kuhn, Corps of Engineers, from November 2, 1906, to May 31, 1907; and in the charge of Capt. Earl I. Brown, Corps of Engineers, since May 31, 1907. Division engineer, Lieut. Col. Dan C. Kingman, Corps of Engineers.

*1. Scuppernong River, North Carolina.*—From the mouth to Columbia is 5 miles; to Spruill's bridge, 23 miles.

Before work was commenced on the river there was only about 5 feet across the bar at its mouth. The upper portion was obstructed by logs, snags, stumps, overhanging growth, and abrupt bends, permitting navigation by small vessels only.

The original project, adopted in 1876, was to dredge the bar, make cut-offs at sharp bends, and remove obstructions so as to obtain a channel 60 feet wide and 9 feet deep at low water up to Spruill's bridge. Prior to 1902 \$8,000 had been expended.

The present project, adopted by act of June 13, 1902, provides for dredging a channel 3,400 feet long, 150 feet wide, and 9 feet deep at mean low water across the bar at the mouth of the river, at a cost of \$14,000.

The project is about 70 per cent completed.

At the end of the year 2,700 feet of the projected channel had been dredged to project depth for a width of 90 feet and the remaining 700 feet to a width of 130 feet.

Expended prior to 1902 on previous project.....	\$8,000. 00
Expended on present project up to June 30, 1907:	
For improvement.....	\$11,500. 00
For maintenance.....	3,469. 97
	<hr/> 14,969. 97
Total.....	<hr/> 22,969. 97

The expenditures for the year were for improvement and maintenance. The shoaled portion of the cut, 90 feet wide, was restored to project depth and the width of 700 feet of the same cut increased to 130 feet.

When active work ceased in 1907 the condition was a channel 90 feet wide with a least depth of 9 feet at mean low water across the bar at the mouth of the river; thence to Cross Landing, 14 miles above, a good open channel of 7 feet at mean low water, free from obstacles; thence to Spruill's bridge, 9 miles farther, 7 feet at mean low water could be carried, but the river in many places was narrow and crooked and obstructed by overhanging trees on the banks and by logs and snags in the channel.

It is proposed to apply the funds on hand to maintenance.

This is a nontidal stream with no slope, the oscillations of the surface being controlled by the winds.

Spruill's bridge, 23 miles from its mouth, is the head of navigation, to which point 7 feet can be carried at mean low water.

The commerce for 1906 amounted to 44,909 tons, valued at approximately \$1,585,175, a decrease of 10,228 tons from last year. It consisted principally of lumber, timber, cotton, and other farm products.

The effect of the project on freight rates is not known.

References: The adopted project is printed in the Annual Report of the Chief of Engineers for 1901, page 1543.

July 1, 1906, balance unexpended.....	\$4,679. 27
Amount appropriated by river and harbor act approved March 2, 1907.....	2,000. 00
	<hr/> 6,679. 27

June 30, 1907, amount expended during fiscal year:

For works of improvement.....	\$3,469. 97
For maintenance of improvement.....	1,179. 27
	<hr/> 4,649. 24

July 1, 1907, balance unexpended.....	2,030. 03
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Amount (estimated) required for completion of existing project.....	2,500. 00
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(See Appendix M 1.)

2. *Fishing Creek, North Carolina.*—When improvement began the stream was badly obstructed by masses of fallen timber, overhanging trees on banks, logs and snags in channel, and was navigable by rafts only a few miles above the mouth.

The original project of 1889 was to clear the stream of logs, snags, trees, etc., up to Bellamy's mill. It was amended in 1896 to limit the work to that part below the Wilmington and Weldon Railroad bridge, and this amended project was completed in 1901. The sum of \$22,715.10 was spent on this project, which has been finished.

Amount expended on present project up to June 30, 1907, for maintenance, \$2,178.70.

The proposed application of the available balance of \$356.20 is to maintain the natural channel as far as Beech Swamp.

Results: The stream has been cleared of obstructions to the Wilmington and Weldon Railroad bridge, but it is not navigable above Beech Swamp on account of its tortuous course and rapid current. Below that point it is navigable during the higher stages about eight months annually.

The extreme lower end of the stream is in good condition. It is reported by those interested in its navigation to be in poor condition from the sixth mile post to Beech Swamp, being badly obstructed by fallen trees, logs, and snags. Between Beech Swamp and the railroad bridge the condition of the stream is unknown, but it is presumably bad. The owners of the vessels navigating this stream report that there are so many obstructions that it is unsafe to navigate unless the water is at least 2 feet higher than the stages at which it was safe to navigate just after the stream had been cleared out.

The present head of navigation is Beech Swamp, 17.5 miles from its mouth, to which about 2 feet can be carried during about three months of the year.

The water surface varies from a minimum depth of 6 inches at low water to 10 feet during the high freshet stages.

The commerce for 1906 amounted to 2,251 tons, valued at approximately \$30,587, a loss of 55 tons from the previous year; it consisted principally of cotton seed, timber, fertilizers, and peanuts.

The effect of the improvement on railroad and boat rates can not be definitely stated; but the stream when opened to navigation affords an outlet to farm products, timber, lumber, etc., which have no other outlet except by wagons.

References: Annual Reports for 1890, page 1179; 1893, page 1377; 1900, page 1796; 1905, page 1203.

July 1, 1906, balance unexpended.....	\$356. 20
July 1, 1907, balance unexpended.....	356. 20

(See Appendix M 2.)

3. *Pamlico and Tar rivers, North Carolina.*—(One river, called the Pamlico below Washington, N. C., and the Tar above that point.) Distance from Washington to Greenville, 22 miles; to Tarboro, 49 miles; to Fishing Creek, 56 miles; to Little Falls, 88 miles; to Rocky Mount, 89 miles.

Prior to its improvement, which was begun in 1876, the stream below Washington was obstructed by war blockades, sunken logs, snags, stumps, and sand shoals.

The governing low-water depths were 5 feet to Washington and perhaps 1 foot to Tarboro, the navigation to which place was practicable during freshet stages only. About 3 feet could be carried to Tarboro during about eight flush-water months per year.

The original project for the improvement of the river below Washington is that submitted in December, 1875 (Report Chief of Engineers, 1876, p. 361), and adopted by Congress in August, 1876, to provide 9 feet at low water, from Washington to its mouth, by dredging and the removal of piles and obstructions at an estimated cost of \$28,050. In the project proper the proposed draft to be provided was not specified, but work under the project was devoted to securing 9 feet at mean low water.

Under this project the sum of \$18,000 was appropriated, of which \$17,877.12 was expended; the remainder, \$122.88, was transferred to



the improvement of the Pamlico and Tar rivers, when the improvements were combined in 1880.

The Tar River (that portion of the stream above Washington), prior to improvement, was obstructed by sunken logs, piles, wrecks, stumps, snags, and trees in the channel, and overhanging trees along its banks.

The original project for this portion of the stream was that of 1879 (Report Chief of Engineers, 1879, p. 700) for the removal of obstructions between Washington and Tarboro at an estimated cost of \$10,000. An appropriation of \$3,000 was made for this purpose in 1879, of which \$2,867.27 was expended, leaving a balance of \$132.73, which was transferred to the joint improvement.

Prior to the consolidation of these two improvements there had been expended under the above projects \$20,744.39. To June 30, 1888, \$37,031.94 had been expended on the consolidated project, to which, adding the aggregate amount expended on the single projects, \$20,744.39, makes the total amount expended for the improvement of this stream \$57,776.33. The total final estimate for the project submitted in 1888 was \$76,000.

In 1889 the project was extended to clear the natural channel above Tarboro, 34 miles to Little Falls, and the estimate was increased \$16,200, making the total estimate \$92,200.

The present project is that of 1875 (for Pamlico River), and of 1879 and 1889 (for Tar River), somewhat modified to secure a channel 100 feet wide and 9 feet deep at mean low water to Washington, thence a channel 60 feet wide and 3 feet deep at low water for 22 miles farther to Greenville; thence a channel 60 feet wide and 20 inches deep at low water for 26 miles farther to Tarboro; thence to keep clear of obstructions the natural channel 34 miles farther to Little Falls, 2 miles below Rocky Mount, N. C.

The project was again modified by act of March 2, 1907, which changed the depth between Washington and Greenville from 3 to 4 feet at mean low water, at an estimated cost of \$3,800.

Expended prior to 1876 on previous projects.....	\$10,000.00
Expended on present project up to June 30, 1907:	
For improvement.....	\$142,976.21
For maintenance.....	21,818.02
	<hr/>
	164,794.23
	<hr/>
	174,794.23

It is proposed to apply the available balance toward completing the channel below Washington and completing the 4-foot channel between Washington and Greenville and for maintenance both above and below Washington.

The expenditures during the year were for improvement below Washington. No work was done above Washington, because the plant was needed more elsewhere.

The controlling depth to Washington is 8.5 feet at mean low water; thence to Greenville, 22 miles, 3.0 feet can be carried at mean low water. Above this point the river is navigable only during the freshet stages, of variable duration, extending over six to eight months of the year.

The stream is nontidal. Below Washington the only surface variations of importance are due to the wind, with an extreme range of 3

feet under normal conditions. Long protracted easterly or westerly winds sometimes cause variations of 7 or 8 feet. The variations of the upper portion of the river are affected by freshets only.

The head of navigation is Dunbar's bridge, 108 miles from the mouth.

The commerce for the year 1906 amounted to 491,384 tons, valued at approximately \$20,816,394, a decrease since the previous year of 75,947 tons. It consisted principally of cotton, cotton-seed products, grains, potatoes, wood, timber, lumber, fertilizers, machinery, general merchandise, etc.

The tendency of the improvement is to keep down freight rates.

References: History and maps, Annual Reports, 1890, page 1114; 1891, page 1347; 1896, pages 161 and 1101.

Examinations and surveys: Annual Reports, 1873, page 555; 1879, page 700; 1891, page 1429; 1895, page 1365; 1897, page 1425; and House Document No. 342, Fifty-ninth Congress, second session.

The project for the work below Washington is about 95 per cent completed; the 3-foot project between Washington and Greenville has been completed and is in good condition. The stretch above Greenville has deteriorated for lack of maintenance.

July 1, 1906, balance unexpended	\$4, 254. 06
Amount appropriated by river and harbor act approved March 2, 1907	11, 563. 00
	<hr/>
June 30, 1907, amount expended during fiscal year, for works of improvement	15, 817. 06
	<hr/>
	7, 375. 64
July 1, 1907, balance unexpended	8, 441. 42
July 1, 1907, outstanding liabilities	2, 333. 07
	<hr/>
July 1, 1907, balance available	6, 108. 35

(See Appendix M 3.)

4. *Contentnia Creek, North Carolina*.—Distance from the mouth to Snow Hill, 31½ miles; Speights Bridge, 50½ miles; Stantonsburg, 63 miles.

Previous to improvement this stream was obstructed throughout its entire length by fallen timber, sand shoals, and overhanging growth, and was navigable for shallow-draft craft during only the higher freshet stages of about three to six months of the year.

The original project of 1881 was to clear the stream of these obstructions, so as to obtain from its mouth to Stantonsburg, 63 miles, a depth of not less than 3 feet during the higher stages, about nine months of the year, at a cost estimated in 1888 at \$77,500.

The project of 1881 as extended in 1894 included maintenance below Snow Hill, and was again extended in 1899 to include maintenance from Stantonsburg to the mouth. The project has been completed, and additional work required is for maintenance.

Amount expended up to June 30, 1907:

For improvement	\$64, 394. 56
For maintenance	8, 837. 60
	<hr/>
Total	73, 232. 16

It is proposed to expend the funds in hand exclusively for maintenance.

At the close of the fiscal year 1907 the creek between its mouth and Snow Hill was in fair condition and could be navigated during six months of the year by boats drawing 3 to 4 feet, depending upon the rainfall. Snow Hill, 31½ miles from its mouth, is practically the head of navigation, although during the higher stages of water boats can ascend the stream to Speights Bridge, 50½ miles from its mouth. The portion of the stream between Snow Hill and Speights Bridge has been partially resnagged since it was originally cleared of obstructions, but no boat has ascended the stream above Snow Hill since the resnagging.

A small amount of snagging was done during the fiscal year between the mouth and thirty-second milepost, leaving the stream in fair condition.

The commerce for the year 1906 amounted to 22,106 tons, valued at approximately \$565,052, an increase of 276 tons, about 12 per cent, over the previous year. It consisted principally of cotton, cottonseed meal, timber, lumber, fertilizer, general merchandise, etc.

The effect of the improvement on railroad and boat rates can not be definitely stated, but the stream when opened to navigation affords an outlet to farm products, timber, lumber, etc., which have no other outlet except by wagon.

References: Annual Reports, 1881, page 1009; 1890, page 1118; 1896, page 1103.

July 1, 1906, balance unexpended.....	\$897. 94
Amount appropriated by river and harbor act approved March 2, 1907.....	2, 000. 00
	<hr/> 2, 897. 94
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	953. 10
	<hr/>
July 1, 1907, balance unexpended.....	1, 944. 84
July 1, 1907, outstanding liabilities.....	2. 75
	<hr/>
July 1, 1907, balance available.....	1, 942. 09
(See Appendix M 4.)	

5. *Neuse and Trent rivers, North Carolina.*—(a) *Neuse River.*—Distance from Newbern to Contentnia Creek, 32 miles; to Kinston 50 miles; to Whitehall, 74 miles; to Goldsboro (Wilmington and Weldon Railroad bridge), 94 miles; to Smithfield, 150 miles.

There is considerable uncertainty as to the conditions existing prior to 1878, when improvement by the Government was begun. Before the civil war, and probably for some time afterwards, light-draft steamers made more or less regular trips as high up as Smithfield, but the low-water depth probably did not exceed 2 feet, and the stream was obstructed by snags and after the civil war by war blockades. (See Annual Report of the Chief of Engineers for 1905, p. 240.)

The original project of 1871, as extended in 1878–79 and 1880 and continued to date, provides for an 8-foot navigation up to Newbern during the entire year, 4 feet to Kinston, and during nine months of the year 3 feet to Smithfield, by the removal of war obstructions, dredging, jettying, and snagging, at a total estimated cost of \$374,000; extended in 1902 to include dredging a channel 300 feet wide below Newbern and 200 feet wide at Newbern, to a depth of 8 feet at dead low water, in accordance with report and estimate printed in Annual Report of the Chief of Engineers for 1905, page 1427, at an estimated

additional cost of \$59,081.25. Since its adoption this additional estimate has been reduced to \$24,000.

In 1902 the improvement of this river was combined with that of Trent.

Amount expended on foregoing projects to June 30, 1907:

For improvement-----	\$326, 758. 93
For maintenance-----	12, 767. 27
Total-----	339, 526. 20

The expenditures for the year were for improvement and consisted of dredging Union Point shoal, just below Newbern, to the project width of 300 feet and depth of 8 feet at dead low water.

As a result of the expenditures to date all war blockades have been cleared away and the natural channel has been cleared to Smithfield, 150 miles above Newbern. No attempt has been made to maintain the stream above Waynesboro Landing (Goldsboro), 98½ miles above Newbern. At low water 8 feet can be carried to Newbern, 4 feet to Village Creek, 25 miles above, 2.5 feet to the mouth of Contentnia Creek, 31½ miles above Newbern, and 1 foot to Kinston, 50 miles above Newbern, above which point the river is navigable only during the freshet stages, of variable durations.

A channel known as the Western channel, immediately above Newbern, has been cleared to a depth of 4 feet at mean low water.

The channel of the river between Newbern and Kinston is free from all obstructions. Between Kinston and Whitehall the channel in many places is badly obstructed by logs, snags, and fallen trees.

The practical head of navigation is Waynesboro Landing, about 136 miles from the mouth of the river.

The stream is nontidal. The variation of the water surface below Newbern is due entirely to the influences of the wind. The maximum range is 3.3 feet during severe northwest winds to 8½ feet during violent northeast gales. The upper river is subject to freshets, which rise 17 feet at Smithfield, 18 feet at Waynesboro Landing, and 20 feet at Kinston.

The funds on hand are to be used for maintenance and in securing the project depth of 4 feet between Newbern and Kinston by repairing the old jetties and training walls, building new ones where necessary, and supplementing the effect of these structures by dredging.

The commerce of the year amounted to 501,315 tons, valued at \$17,967,655 (a gain since last year of 31,916 tons). It consisted of grain, timber, lumber, fertilizers, general merchandise, etc.

Freight rates are materially lessened by reason of the improvement.

References: See Annual Reports of 1879, page 71; 1900, pages 268 and 1802; 1901, page 1545.

July 1, 1906, balance unexpended-----	\$5, 067. 25
Amount allotted from appropriation by river and harbor act approved	
March 2, 1907-----	18, 000. 00
Amount received from sales, rents, etc-----	47. 20
	23, 114. 45
June 30, 1907, amount expended during fiscal year, for works of improvement -----	4, 921. 55
July 1, 1907, balance unexpended-----	18, 192. 90
Amount (estimated) required for completion of existing project-----	72, 500. 00

(b) *Trent River*.—Distance from the mouth at Newbern to Pollokville, 18 miles; to lower Quaker bridge, 27 miles; to Trenton, 38 miles. Its original condition was a channel of 6 feet depth to Pollokville, and the stream was fairly clear to lower Quaker bridge, above which point it was badly obstructed.

The original project of 1879 (see Report of Chief of Engineers for 1879, p. 711) was to secure 3 feet depth at low water to Trenton; extended in 1886 to obtain 8 feet depth through Foys flats; extended in 1889 to clear out obstructions to upper Quaker bridge, 40 miles above Trenton. The sum of \$64,262.64 was expended on this project and its modifications.

In 1896 the project of 1879 was amended to provide for the maintenance of a channel only 30 feet wide and 3 feet deep from Newbern to Trenton, at an annual estimated cost of \$2,500. This was extended in 1902 to include dredging at Newbern to 8 feet depth at dead low water from harbor line to channel, at an estimated cost of \$24,000 additional. The existing project, therefore, is to dredge to 8 feet dead low water at Newbern and maintain a channel 30 feet wide and 3 feet deep at low water to Trenton. In 1902 the improvement of this river was combined with that of the Neuse.

The project was completed during the year.

By joint resolution approved March 4, 1907, authority was given to expend such portion of the appropriation made in river and harbor act of March 2, 1907, as may be necessary for securing a channel 6 feet deep over Foys flats in the Trent River, about 4 miles above Newbern.

Amount expended on existing project up to June 30, 1907:

For improvement -----	\$23, 738. 61
For maintenance -----	11, 731. 80
Total -----	35, 470. 41

The disbursements for the year for improvement were for completing the removal of the rest of the shoal lying between the channel and the harbor line at Newbern, and the disbursements of year for maintenance were for repairs to the turning basin at Trenton and snagging between Trenton and Newbern.

In addition to maintenance of the present channel to Trenton, the work proposed with the funds available is to deepen to 6 feet, by dredging the channel over Foys flats, about 4 miles above Newbern.

The improvement above Trenton has been abandoned.

Between Trenton and Newbern a 3-foot channel exists and the stream is in good condition. The maximum draft that can be carried June 30, 1907, to Trenton, 38 miles above the mouth, which is the head of navigation, is 3 feet.

Near the mouth the water level varies about 3 feet under normal conditions, according to the prevailing winds. Long protracted easterly or westerly winds sometimes cause a variation of 7 or 8 feet. At Trenton the stream is subject to freshets of about 3 to 5 feet during the winter months.

The commerce during 1906 amounted to 343,507 tons, valued at \$15,456,539, a gain of 81,372 tons over the previous year. It consisted principally of lumber, general merchandise, fertilizers, cotton, and other farm products.

The effect of this improvement on freight rates is not known.

References: Annual Reports, 1879, page 711; 1900, pages 268 and 1802; 1901, page 1545.

July 1, 1906, balance unexpended.....	\$5,999. 17
Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	12,000. 00
	<hr/> 17,999. 17
June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$5,000. 00
For maintenance of improvement.....	883. 32
	<hr/> 5,883. 32
July 1, 1907, balance unexpended.....	12,115. 85
July 1, 1907, outstanding liabilities.....	65. 00
	<hr/>
July 1, 1907, balance available.....	12,050. 85

## CONSOLIDATED.

July 1, 1906, balance unexpended.....	\$11,066. 42
Amount appropriated by river and harbor act approved March 2, 1907.....	30,000. 00
Amount received from sales, rents, etc.....	47. 20
	<hr/> 41,113. 62
June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$9,921. 55
For maintenance of improvement.....	883. 32
	<hr/> 10,804. 87
July 1, 1907, balance unexpended.....	30,308. 75
July 1, 1907, outstanding liabilities.....	65. 00
	<hr/>
July 1, 1907, balance available.....	30,243. 75
Amount (estimated) required for completion of existing project.....	72,500. 00

(See Appendix M 5.)

6. *Inland waterway from Pamlico Sound to Beaufort Inlet, North Carolina.*—Distance from the 10-foot mean low-water contour in Adams Creek (a tributary of the Neuse River) to the head of Adams Creek is about 4 miles; from the head of Adams Creek across the country to the head of Core Creek is about 4 miles; from the head of Core Creek to the mouth of Core Creek is about 4 miles; and the distance from the mouth of Core Creek to the 10-foot depth at mean low water in the Newport River is about 3 miles; making the total distance over which dredging will be required about 15 miles.

At the time of the adoption of the existing project a low-water depth of about 5 feet could be carried from the 10-foot contour in Adams Creek to near its head; from the head of Adams Creek to the head of Core Creek is across dry land; from the head of Core Creek to its mouth the creek is practically bare at low water, and from the mouth of Core Creek to the 10-foot contour in Newport River the low-water depth will average about 6 feet.

The present and only project, adopted by act of Congress dated March 2, 1907, contemplates securing, by dredging a channel 10 feet deep at low water from Pamlico Sound to Beaufort Inlet via Adams and Core creeks, said channel to have a minimum bottom width of 90 feet through dry land with side slopes of 1 to 2½ and minimum bottom width of 125 feet with side slopes of 1 to 3 through the creek and

river portions, at an estimated cost of \$550,000. (See House Document No. 84, Fifty-ninth Congress, second session.)

Amount expended on project for improvement to June 30, 1907, \$924.91.

The work of the year consisted of surveying to definitely locate the route for the proposed waterway. This survey is about half completed.

The river and harbor act of March 2, 1907, authorized continuing contracts for completing the project in the sum of \$350,000, which is yet to be appropriated.

References to previous reports on examinations and surveys will be found on pages 1393 and 1394 of the Annual Report of the Chief of Engineers for 1904.

Amount appropriated by river and harbor act approved March 2, 1907-----	\$200,000.00
June 30, 1907, amount expended during fiscal year, for works of improvement-----	924.91
July 1, 1907, balance unexpended-----	199,075.09
July 1, 1907, outstanding liabilities-----	848.40
July 1, 1907, balance available-----	198,226.69
Amount (estimated) required for completion of existing project-----	350,000.00
<hr/>	
{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907-----	
Submitted in compliance with requirements of sundry civil act of June 4, 1897.	
350,000.00	

(See Appendix M 6.)

7. *Waterway between Newbern and Beaufort, N. C. (via Neuse River, Clubfoot Creek, Clubfoot and Harlowe Canal (private), Harlowe Creek, and Newport River).*—Distances: Newbern to Clubfoot Creek, 20 miles; thence to Clubfoot and Harlowe Canal, 6 miles; thence to Harlowe Creek, 3.2 miles; thence to Newport River, 3½ miles; thence to Beaufort, 7 miles.

The first appropriation for this work was made by the river and harbor act of 1882, which provided that \$5,000 from the appropriation for Neuse River and a like sum from the appropriation for Beaufort Harbor should be "applied to the improvement of the line of inland navigation from Newbern to Beaufort Harbor."

No estimate or project for said improvement had at that time been made, but in October, 1883 (Report Chief of Engineers, 1884, p. 1067), an estimate was prepared which contemplated a channel 80 feet wide and 9 feet deep, at an estimated cost of \$883,580, exclusive of the cost of a tide lock and of the canal company's franchise and property.

The available funds being totally inadequate for this improvement, the project adopted in 1884 for the expenditure of said funds contemplated a channel 30 feet wide and 5 feet deep at mean low water, the estimated cost being \$92,000.

This project of 1884 constitutes the existing project.

All work of improvement has been confined to the natural channels in Clubfoot and Harlowe creeks and Newport River.

Amount expended on existing project to June 30, 1907:

For improvement .....	\$29, 739. 84
For maintenance .....	5, 228. 56
Total .....	34, 968. 40

The expenditures during the year were for improvement by dredging a cut 1,100 feet long, 5 feet deep, and 25 feet wide from the shoal near the head of Clubfoot Creek.

The governing depth in Harlowe Creek was increased several years ago to the project depth of 5 feet, but for lack of maintenance had decreased to about 1 foot in 1905. During that year the shoal at the mouth of the creek was redredged to the project depth, but another shoal of less consequence was left inside the creek. The channel in Clubfoot Creek had never been dredged until the fiscal year 1906. Some snagging, etc., had been done in both creeks, but no work in the canal connecting the two creeks has ever been done by the Government, since said canal is owned by a corporation.

The dredged cut at the mouth of Harlowe Creek has deteriorated considerably since its completion, but on account of the dredging done in Clubfoot Creek during the fiscal year 1906 and the past year the waterway is, on the whole, in better condition now than ever before. The controlling depth at mean low water is now from 2 to 2½ feet, the shoalest place being near the mouth of Harlowe Creek; but at high water about 4 feet can be carried, shoalest water being in the canal.

It is proposed to apply the available balance to maintenance.

Additional improvement will not be necessary because of the project for the inland waterway, Pamlico Sound to Beaufort Inlet, for which Congress provided \$550,000 March 2, 1907. When this improvement is effected, the present route via Clubfoot and Harlowe Canal will no longer be required.

The commerce for the year ending December 31, 1906, amounted to 81,770 tons, valued at approximately \$2,173,904, and consisted principally of cotton, cotton seed, fish, oysters, clams, timber, lumber, fertilizers, and general merchandise. There was a loss of 1,897 tons in volume as compared with 1905.

References: Annual Reports, 1884, page 106; 1890, page 1130, and 1896, page 113.

July 1, 1906, balance unexpended.....	\$464. 45
Amount appropriated by river and harbor act approved March 2, 1907.....	2, 000. 00
	<hr/> 2,464. 45
June 30, 1907, amount expended during fiscal year, for works of improvement.....	432. 85
July 1, 1907, balance unexpended.....	<hr/> 2, 031. 60
Amount (estimated) required for completion of existing project....	55, 000. 00

(See Appendix M 7.)

8. *Harbor at Beaufort, N. C.*—When improvement (begun in 1836) was resumed in 1881, the erosion at Fort Macon and Shackelford Point was causing serious deterioration of the inside channels and threatening deterioration of the bar channel. The governing low-



water depth is said to have been 15 feet on the bar and 2 feet at Beaufort, N. C.

The original project is that of 1881, to stop erosion at the inlet (Fort Macon and Shackelford Point) by jetties and to provide a channel 200 feet wide and 9 feet deep at ordinary low tide to Beaufort, and a channel 100 feet wide and 6 feet deep from Beaufort to the 6-foot contour of the channel leading up North River, estimated to cost \$82,103.38, increased in 1885 to \$159,000, when the project was modified by reducing the channel to Beaufort to 100 feet and its depth to 5 feet at mean low water and eliminating the channel east from Beaufort. In 1887 the estimate for the above work was further increased to \$163,000.

The project was again modified in 1890, the project depth of the bulkhead channel being increased to 7 feet. The project as modified was completed.

The amount expended under the original project as modified was \$148,843. To the above amount should be added \$5,000, appropriated July 4, 1836, making the total cost up to the completion of the original project \$153,843.

The existing project of 1896 includes the maintenance of jetties and sand fences at Fort Macon and Shackelford Point and the maintenance of the 7-foot channel across Bulkhead shoal and thence to the wharves at Beaufort. The object of the jetties and sand fences is to protect the land on the opposite sides of the inlet, thus preventing the inlet from shifting and deteriorating. The river and harbor act of March 2, 1907, authorized a sufficient amount of the appropriation made therein to be applied to repairing existing jetties at Fort Macon Point and constructing additional jetties and shore protection.

The amount expended on present project for maintenance to June 30, 1907, was \$13,250.19, including \$350 received from sales.

The expenditures for the year were for maintenance, and the work consisted of making surveys, the partial removal of the remains of the inner or western spur jetty at Fort Macon Point, which was flanked in December, 1906, and the building of two other jetties at Fort Macon Point with the stone removed from the old jetty.

It is proposed to spend the available balance in dredging channel across Bulkhead shoal; maintaining sand fences at Fort Macon and Shackelford points; completing the removal of the old jetty, and constructing new jetties at Fort Macon Point.

A draft of 7 feet can now be carried across Bulkhead shoal, and 6 feet can be carried from there to the wharves at Beaufort at mean low water.

The tide rises 2 feet at Beaufort and 3 feet at the inlet.

The commerce for the year 1906 amounted to 58,889 tons, valued at approximately \$3,970,885, a decrease of 7,767 tons since the previous year.

The maintenance of this channel tends to prevent the rise in freight rates by allowing the larger vessels to reach the wharves at Beaufort.

References: Annual Reports, 1881, page 1013; 1893, page 1457; 1896, page 1115; 1899, page 1498.

July 1, 1906, balance unexpended-----	\$196. 03
Amount appropriated by river and harbor act approved March 2, 1907-----	22, 000. 00
	<hr/>
	22, 196. 03
June 30, 1907, amount expended during fiscal year, for maintenance of improvement-----	939. 22
	<hr/>
July 1, 1907, balance unexpended-----	21, 256. 81
July 1, 1907, outstanding liabilities-----	1, 264. 19
	<hr/>
July 1, 1907, balance available-----	19, 992. 62
(See Appendix M 8.)	

9. *Beaufort Inlet, North Carolina.*—When improvement began in September, 1905, there was a minimum depth on the bar of approximately 12 feet at mean low water.

The original project, which is also the existing project, is printed on page 1415 of the Annual Report of the Chief of Engineers for 1904 and was adopted by Congress in 1905. It contemplates a channel 300 feet wide, 20 feet deep at mean low water across the bar, to be obtained by dredging, at an estimated cost of \$45,000.

The amount expended on existing project to June 30, 1907, for improvement was \$44,484.24.

The work to date has consisted of the necessary surveys, etc., and the dredging of 426,630 cubic yards of material from the bar channel. The dredging was done by the United States seagoing suction dredge *Cape Fear*, which belongs to the improvement of the Cape Fear River, North Carolina, at and below Wilmington, but which was rented to the improvement of Beaufort Inlet for the purpose. This dredge was operated by a crew hired by the United States. The result of the operations to date has been an increase of the minimum depth on the bar from 10.8 feet at mean low water when work began to about 20 feet on June 30, 1907, the width and average depth of the channel having been likewise increased.

The expenditures of the year resulted in the removal of 221,852 cubic yards of material from the bar channel. There is no reliable survey of a recent date, but from an examination made during the latter part of May, 1907, the minimum depth was found to be 20 feet, and the minimum width approximately 200 feet.

It is proposed to apply the available balance to the work of maintenance. The amount required for maintenance can not be determined with much certainty, for the reason that the amount of shoaling that will take place in the new and untried channel is necessarily problematic.

The commerce for the calendar year 1906 amounted to 10,465 tons, valued at \$457,900, a decrease of 5,189 tons as compared with 1905.

The effect of this improvement will be to lessen freight rates by affording water transportation for products which have hitherto been dependent entirely upon railroads.

References: Annual Reports, 1881, page 1009; 1890, page 1118; 1896, page 1103.

July 1, 1906, balance unexpended.....	\$29, 022. 46
Amount appropriated by river and harbor act approved March 2, 1907.....	5, 000. 00
	<hr/>
	34, 022. 46
June 30, 1907, amount expended during fiscal year, for works of improvement.....	28, 506. 70
	<hr/>

July 1, 1907, balance unexpended..... 5, 515. 76

(See Appendix M 9.)

10. *New River, North Carolina, including inland waterways between Beaufort Harbor and New River and between New River and Swansboro.*—The act of March 2, 1907, combined these three improvements under this new heading.

(a) *New River.*—Appropriations amounting to \$50,000 were made for the river in 1836, 1837, and 1838, after which no further appropriations were made until 1882, when \$5,000 was appropriated. Another appropriation of \$5,000 was made in 1884, but since these amounts were considered too small to justify undertaking the improvement no work was done until 1886, when still another appropriation, of \$10,000, was made.

When improvement began in 1886, the governing low-water depth was 4 feet for a distance of 23 miles to Jacksonville, and the channel included two circuitous parts around Wrights Island and Cedar Bush Marsh.

The original project of 1886 was to dredge a cut 4 feet deep and 100 feet wide through Wrights Island and a second cut 4 feet deep and 150 feet wide through Cedar Bush Marsh. Both were completed, but the Cedar Bush Marsh cut deteriorated at the upper end and was abandoned, and the project of June 18, 1894, to obtain 4 feet depth around Cedar Bush Marsh by dredging and training wall, was adopted and successfully carried out. The additional work required is for maintenance.

The act of March 3, 1905, authorized the balance from the project of 1894, to be expended in rebuilding the dike hitherto constructed.

Amount expended since civil war on previous projects.....	\$20, 442. 35
Amount expended on present project of 1894 (as amended to date)	

up to June 30, 1907:

For improvement.....	9, 186. 39
----------------------	------------

For maintenance (including rebuilding dike).....	3, 373. 31
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Total.....	33, 002. 05
------------	-------------

The expenditure during the year was for surveying and collecting commercial statistics.

It is proposed to apply the existing balance to maintenance.

The project depth of 4 feet has twice been obtained and twice lost through lack of maintenance. The project depth now exists. The tidal range at the inlet is about  $3\frac{1}{2}$  feet and at the head of the marshes about 1 foot. The head of navigation for all practical purposes is Tar Landing, 3 miles above Jacksonville and 26 miles from the mouth of the river, to which a present depth of approximately 4 feet can be carried. It is reported that the depth on the bar at the mouth of the river is about 4 feet.

The commerce for 1906 amounted to 13,660 tons, valued at approximately \$500,504, a decrease of 2,138 tons since the previous year. It

consisted principally of timber, fish, cotton, cotton seed, and general merchandise.

In its present condition this stream probably has very little effect on freight rates in general, but it affords transportation for products which would otherwise have no means of transportation except by wagon. If the bar and channel were sufficiently improved to justify a line of steam vessels between Wilmington and Jacksonville, freight could probably be carried to the latter point much more cheaply than at present.

References: Annual Reports, 1882, page 1117; 1886, page 992; 1891, page 1380; 1899, page 1501, and Appendix M 19 of Report of Chief of Engineers for 1904 for report on preliminary examination.

July 1, 1906, balance unexpended.....	\$133. 04
Amount allotted from appropriation by river and harbor act approved	
March 2, 1907.....	2, 000. 00
	<hr/> 2, 133. 04
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	134. 99
July 1, 1907, balance unexpended.....	1, 998. 05
July 1, 1907, outstanding liabilities.....	2. 85
	<hr/> 1, 995. 20
July 1, 1907, balance available.....	1, 995. 20

(b) *Waterway between New River and Swansboro, N. C.*—This waterway is a part of the waterway between Beaufort Harbor and New River (see pp. 1124–1127, Annual Report of the Chief of Engineers for 1889), but in 1890 two separate appropriations were made—one for the “Inland waterway between Beaufort Harbor and New River” and the other for the “Waterway between New River and Swansboro,” and hence separate reports are made for the two improvements, although one embraces the other.

This waterway is about 22 miles long and consists of tortuous tidal channels winding through the marine marsh, which extends from Swansboro to New River, between the mainland on one side and the barrier beach or “banks” (which separates it from the ocean) on the other. In the vicinity of the four inlets communicating with the ocean the width of the waterway is several hundred feet and its depth from 12 to 15 feet, while between them its width diminishes to about 12 feet in places and its depth to 6 inches at ordinary low water.

The original and existing project, adopted in 1889, is to enlarge the waterway by dredging to a minimum width of 40 feet and minimum depth of 3 to 4 feet at mean high water, at an estimated total cost of \$43,000.

Until June 13, 1906, no work except a survey made in April and May, 1901, had ever been done on this waterway, for the reason that an act of the general assembly of North Carolina, ratified February 13, 1889, had incorporated the Wrightsville and Onslow Navigation Company with the exclusive right to navigate said waterway, as set forth in House Executive Document No. 26, Fifty-second Congress, first session (p. 1147 of the Annual Report of the Chief of Engineers for 1892).

On February 6, 1905, however, a paper was obtained from the two survivors of the four parties named in the charter of said Wrightsville

and Onslow Navigation Company, in which paper it was declared that the privileges and franchises granted in said charter had never been exercised and that said privileges and franchises had "to all intents and purposes been surrendered and abandoned."

All obstacles in the way of Government improvement having been thus removed, work was begun as soon as plant for the purpose could be spared from other more pressing work.

The amount expended to June 30, 1907, on surveys and improvement is \$5,000.

The expenses of the year, which include the outstanding liabilities at the beginning of the year, were \$3,224.40, all for improvement, by dredging at Standback shoal and Sand shoal, resulting in obtaining a channel 25 feet wide of the project depth through Standback shoal and a channel of the same width and depth about half-way through Sand shoal.

Owing to the small amount of funds available work is being directed toward getting a single narrow and shallow cut through as much of the length of the waterway as possible. To June 30, 1907, a depth of 3.5 feet at high water had been obtained from Swansboro to a point in the waterway about 15 miles west of Swansboro.

It is proposed to expend the available balance in carrying the 3.5-foot depth as far westward as practicable.

Except for the work above described, the present conditions are similar to those existing prior to the formation of the project.

The waterway is navigable at high tide for very small boats throughout its entire length, a distance of approximately 22 miles. At mean low water some of the shoals are bare.

The rise and fall of the tide varies from 2.2 to 4 feet in the neighborhood of the inlets to about 1 foot at the points most distant from the inlets.

The commerce of 1906 amounted to 6,686 tons, at an approximate value of \$355,950, a gain of 5,303 tons over that of the previous year. It consisted principally of cotton, fish, oysters, clams, and fertilizers. This can not be taken as an indication of the amount of commerce that will utilize the waterway after the proposed improvement is made, for the difficulty and delay incident to navigation now are so great that commerce naturally seeks other routes.

The improvement of this waterway will probably have no direct effect upon freight rates, but it will afford means of transportation for large quantities of timber, lumber, and miscellaneous products that now have no outlet except by wagon or by the smallest draft boats.

References: For description of this waterway see Annual Reports for 1892, page 1146, and 1893, pages 1399 and 1400.

July 1, 1906, balance unexpended.....	\$3, 224. 40
Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	12, 000. 00
	<hr/>
	15, 224. 40
June 30, 1907, amount expended during fiscal year, for works of im- provement .....	3, 224. 40
	<hr/>
July 1, 1907, balance unexpended.....	12, 000. 00
	<hr/>
Amount (estimated) required for completion of existing project.....	26, 000. 00

(c) *Waterway between Beaufort Harbor and New River (i. e., portion between Beaufort and Swansboro).*—Distance from Beaufort to Swansboro, 30 miles, with access at Swansboro to the Atlantic Ocean through Bogue Inlet.

When improvement began in 1886 the governing low-water depth was 18 inches to Swansboro.

The original project is that of 1885, to provide a channel 100 feet wide and 3 feet deep at ordinary low water between Beaufort Harbor and Swansboro, estimated to cost \$6,000. This estimate was increased in 1887 to \$50,000 and again increased in 1892 to \$71,040.

No project was adopted originally for the part beyond Swansboro, but in 1889 a separate project for a channel 40 feet wide by 3 or 4 feet deep over this portion of the waterway was adopted, the estimated cost being \$43,000. The act of 1890 made a separate appropriation of \$5,000 for this portion of the route, designating it as the "Waterway between New River and Swansboro." (See pp. 1376-1378, Report of the Chief of Engineers for 1891.)

The project is about 85 per cent completed.

The amount expended on present project to June 30, 1907, for improvement, is \$50,982.36.

No work was done during the fiscal year, the expenditures, amounting to \$293.02, being for repairs to plant and collecting commercial statistics.

At the close of the fiscal year the project depth of 3 feet prevailed throughout the entire length of 30 miles between Beaufort Harbor and Swansboro, the dredged channel being 100 feet wide (project width) through one shoal 980 feet long, 60 feet wide through six shoals aggregating 24,696 feet in length, and 40 feet wide through another shoal 874 feet long.

It is reported that no shoaling of any consequence has taken place in the past year, and hence the above conditions may be taken as the conditions prevailing June 30, 1907.

The tide at Beaufort Inlet at the eastern end of this waterway and at Bogue Inlet (the western end of the portion improved under appropriations for waterway between Beaufort Harbor and New River) has a range of about  $3\frac{1}{2}$  feet. Where the tides meet in Bogue Sound the range is only about 1 foot.

The commerce during the calendar year 1906 amounted to 29,602 tons, valued at \$1,634,600, a loss as compared with 1905 of 946 tons. The commerce consisted chiefly of lumber, shingles, etc., fish, oysters, and clams, rosin and turpentine, miscellaneous farm products, fertilizers, and general merchandise.

It is proposed to use the balance of funds remaining unexpended in maintenance and in increasing the width of the dredged cuts to the project width of 100 feet.

References: Annual Report, 1885, page 1133; 1891, page 1378; 1892, page 1141; 1893, page 1397; 1894, page 1034; 1896, page 1117; 1897, page 1398.

July 1, 1906, balance unexpended.....	\$2, 310. 66
Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	3, 000. 00
	<hr/> 5, 310. 66
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	293. 02
	<hr/> 5, 017. 64
July 1, 1907, balance unexpended.....	5, 017. 64
Amount (estimated) required for completion of existing project....	16, 040. 00

## CONSOLIDATED.

July 1, 1906, balance unexpended.....	\$5, 668. 10
Amount appropriated by river and harbor act approved March 2, 1907.....	17, 000. 00
	<hr/> 22, 668. 10
June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$3, 224. 40
For maintenance of improvement.....	428. 01
	<hr/> 3, 652. 41
July 1, 1907, balance unexpended.....	19, 015. 69
July 1, 1907, outstanding liabilities.....	2. 85
	<hr/> 19, 012. 84
Amount (estimated) required for completion of existing project....	42, 040. 00

(See Appendix M 10.)

11. *Northeast and Black rivers, and Cape Fear River above Wilmington, N. C.*—(a) *Northeast River.*—Distance from mouth to Bannerman's bridge, 48 miles; to Hallsville, 88 miles; to Kornegay's bridge, the head of navigation, 103 miles.

The original condition when improvement began was a channel badly obstructed by logs, snags, and overhanging trees. The river was navigable to Bannerman's bridge, with governing low-water depth of 6 feet.

The original project of 1889 is still in force and includes the clearing of the natural channel for small steamers to Hallsville and for pole boats to Kornegay's bridge at an estimated cost of \$30,000. Additional work proposed is for maintenance only. Work on the project is 60 per cent completed.

Amount expended on present project up to June 30, 1907:

For improvement .....	\$10, 687. 96
For maintenance .....	10, 031. 75
	<hr/>
Total .....	20, 719. 71

The expenditures of the year were for maintenance in snagging between the thirty-seventh and the sixty-second mileposts. It is proposed to expend the available balance in maintenance.

As the result of the expenditures to date the channel has been kept cleared, except when funds were too low and when it has been impracticable on account of low water or for other causes for the plant to work. Six feet of water can be carried to Bannerman's bridge and 3 feet to Croom's bridge during all stages of the water.

From Croom's bridge to Kornegay's bridge, the head of navigation, the river is so shallow that navigation is practicable only when the

water is up. This is liable to occur at any time, but during the summer low stages usually prevail.

There is a tidal range of about 2 feet at the mouth of this stream, which decreases to nothing at or a short distance above Bannerman's bridge.

The channel is at present badly obstructed by snags, etc., above the sixty-eighth milepost and is partially obstructed below that point.

The commerce for 1906 amounted to 106,151 tons, estimated at approximately \$1,314,946; a decrease of 5,828 tons in amount and \$22,582 in value since the previous year. It consisted principally of timber, naval stores, fertilizers, general merchandise, cotton, and miscellaneous farm products.

The commerce is handled on a few boats that make some attempt at regular trips, and on a large number of rafts, flats, etc. Hence it is impossible to estimate the commerce with much accuracy.

References: Annual Reports, 1885, page 1123; 1890, page 1181; 1895, page 1389, and 1896, page 1122; and House Document No. 229, Fifty-ninth Congress, first session.

July 1, 1906, balance unexpended.....	\$1, 365. 55
Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	2, 000. 00
	<hr/> 3, 365. 55
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	341. 93
July 1, 1907, balance unexpended.....	3, 023. 62
July 1, 1907, outstanding liabilities.....	1. 75
	<hr/> 3, 021. 87
July 1, 1907, balance available.....	3, 021. 87

(b) *Black River*.—The original condition when improvement began was a natural channel cleared fairly to Point Caswell and roughly to Lisbon, with governing low-water depths of 4 feet to Point Caswell, 2.5 feet to Haws Narrows, and 1.5 feet to Lisbon.

The original project of 1885 included clearing the natural channel and banks to Lisbon and the cutting off of a few sharp points at bends. It was amended in May, 1893, by omitting that part of the river above Clear Run, and, as amended, was completed September 20, 1895.

The existing project of 1894 is to maintain the natural channel to Clear Run, at an estimated cost of \$2,000 per annum.

Amount expended to June 30, 1907:	
On previous project mentioned above.....	\$12, 358. 40
On present project, for maintenance.....	9, 206. 17
	<hr/> 21, 564. 57
Total.....	21, 564. 57

During the year ending June 30, 1907, the disbursements amounted to \$721.39. Deducting \$178.82 for liabilities outstanding at the beginning of the year, the cost of the year's work is found to be \$542.57. This was all for maintenance and was spent in removing all the worst obstructions between the forty-third and seventy-fifth mile boards. There are still a number of snags, however, which obstruct the channel at low stages. They are not in the way at high stages, and in fact are difficult to find when the water is high enough to carry the snag boat.



The result obtained by the expenditures to date has been a cleared channel whenever funds were available, permitting navigation to Point Caswell, 24 miles above the mouth, at all stages, and to Clear Run, 66 miles above the mouth, at stages of 1.5 feet or higher above low water, the governing low-water depths at present being 5 feet to Point Caswell, 2.5 feet to Haws Narrows, 32 miles above the mouth, and 1.5 feet to Clear Run. There is no steamboat navigation above Clear Run. Lisbon, 74 miles from the mouth, is the head of navigation. The low-water stages prevail usually from May to August, inclusive; during the rest of the year the stage is about 5 to 8 feet higher, but the periods of high and low water are by no means the same every year. No further work, excepting maintenance, is now proposed.

It is proposed to expend the available balance for maintenance.

The commerce during 1906 amounted to 57,053 tons, estimated value, \$1,186,334, a decrease of 11,582 tons, and a decrease \$213,056 in value as compared with 1905. It consisted principally of timber, general merchandise, naval stores, fertilizers, cotton, and other farm products. The commerce is handled on a few boats, which make some attempt at regularity, and on a large number of rafts, flats, etc., whose trips are altogether irregular. Hence it is impossible to get the commercial statistics with even fair accuracy.

References: For history, see Annual Report for 1896, page 1125. For report on examination, see Annual Reports for 1884, page 1061, and 1885, page 1145.

July 1, 1906, balance unexpended	\$1,900. 16
Amount allotted from appropriation by river and harbor act approved March 2, 1907	2,000. 00
	3,900. 16
June 30, 1907, amount expended during fiscal year, for maintenance of improvement	721. 39
July 1, 1907, balance unexpended	3,178. 77

(c) *Cape Fear River above Wilmington, N. C.*—The original condition when work began was a channel badly obstructed above Kellys Cove by logs, snags, etc., and with governing low-water depths of 4 feet to Kellys Cove and 1 foot to Fayetteville.

The original project of January 26, 1881, was to clear the river to Fayetteville and obtain a continuous channel by jettying and dredging, estimated in July, 1893, to cost \$275,000 for a channel 4 feet deep to Elizabethtown, and 3 feet deep to Fayetteville. It is about 30 per cent completed.

The existing project, adopted by act of June 13, 1902, is to obtain, by canalizing, a low-water depth of 8 feet to Fayetteville, at an estimated cost of \$1,350,000.

In consequence of this new project the former project has been abandoned, excepting for the maintenance of the natural channel, pending the construction of locks and dams.

Amount expended on above project to June 30, 1907:

For improvement	\$134,436. 96
For maintenance	16,706. 48
Total	151,143. 44

The expenditures for the year were for maintenance. As there were outstanding liabilities amounting to \$214.01 at the beginning of the year (none at the end), the total cost of the year's maintenance work was \$1,702.35. This was all for snagging. Snagging operations were conducted during July, October, November, and December, 1906, all the worst snags between Fayetteville and the mouth of Black River being removed.

At present the low-water depths are 8 feet to Kings Bluff, 38 miles above Wilmington; 2½ feet to Elizabethtown, 73 miles above Wilmington, and 2 feet to Fayetteville, 115 miles above Wilmington. Fayetteville is the head of navigation. Low-water stages prevail from two to four months during each summer, and freshets, which raise the water level from 15 to 50 feet at Fayetteville (the effects lower down being less marked), usually occur as often as once a month during the rest of the year. They do not occur with any regularity, however.

The commerce for 1906 was estimated at 135,991 tons, estimated to be worth \$3,630,075. This indicates a decrease of 3,800 tons and of \$907,537 in value as compared with 1905. The principal decrease was in timber. The decrease in timber was probably due to the decreasing abundance of timber. As in the case of the Northeast and Black rivers, however, it is impossible to get the commerce with much accuracy, and it is possible that there was no real decrease.

*Locks and dams.*—The act of June 13, 1902, appropriated \$50,000 for the purchase of sites for locks and dams. A careful survey, consuming more than eleven months' time, was made for the purpose of locating the sites. This survey has been completed, the sites tentatively located, a number of borings made at each site, the locations approved, and prices obtained on all the lands necessary.

Abstracts of the titles have been made and turned over to the United States district attorney for examination. The titles to the land needed at lower site have been approved, and the land purchased. Owing probably to defective records, the purchase of the other land has been delayed, and in some cases it may be necessary to resort to condemnation proceedings.

The expenditures to June 30, 1907, on said project for surveys, other preliminaries, and purchasing land at lower site, amounted to \$14,100.83.

The expenditures for the year were for the purchase of land for the lower dam site, purchasing stone markers for the land and stones for bench marks; keeping water-gauge records, negotiating for the purchase of land, and in inspecting river and proposed sites.

References: Annual Reports for 1872, page 742; 1881, page 1018; 1901, page 1559, and 1904, page 1493.

CAPE FEAR RIVER ABOVE WILMINGTON, N. C., OPEN-CHANNEL WORK.

July 1, 1906, balance unexpended.....	\$4,437.25
Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	5,000.00
	<hr/>
	9,437.25
June 30, 1907, amount expended during fiscal year, for maintenance of improvement .....	1,916.36
	<hr/>
July 1, 1907, balance unexpended.....	7,520.89

## CONSOLIDATED.

July 1, 1906, balance unexpended-----	\$7, 702. 96
Amount appropriated by river and harbor act approved March 2, 1907-----	9, 000. 00
	<hr/> 16, 702. 96
June 30, 1907, amount expended during fiscal year, for maintenance of improvement -----	2, 979. 38
	<hr/>
July 1, 1907, balance unexpended-----	13, 723. 58
July 1, 1907, outstanding liabilities-----	1. 75
	<hr/>
July 1, 1907, balance available-----	13, 721. 83

## CAPE FEAR RIVER ABOVE WILMINGTON, N. C., LOCKS AND DAMS.

July 1, 1906, balance unexpended-----	\$37, 569. 99
June 30, 1907, amount expended during fiscal year, for works of improvement-----	1, 670. 82
	<hr/>
July 1, 1907, balance unexpended-----	35, 899. 17
July 1, 1907, outstanding liabilities-----	32. 85
	<hr/>
July 1, 1907, balance available-----	35, 866. 32

Amount (estimated) required for completion of existing project-- 1, 300, 000. 00  
(See Appendix M 11.)

12. *Cape Fear River, North Carolina, at and below Wilmington.*—The condition of the river prior to the opening of New Inlet (which seems to have occurred during an equinoctial storm in 1761) is rather uncertain, but old maps indicate that there was a low-water depth of 14 feet across the bar at the mouth, the least depth between Wilmington and the mouth being 7.5 feet. There is also some uncertainty as to the conditions in 1829, when the improvement was first undertaken by the United States, but the most reliable information is that there was then about 7 to 7.5 feet at low water in the river, about 9 feet in Baldhead channel, 9 feet in the Rip channel, and 10 feet at New Inlet. Work on the bar was first begun in 1853, at which time the bar depths at low water were 7.5 feet in Baldhead channel, 7 feet in Rip channel, and 8 feet at New Inlet, the governing low-water depths in the river having been increased to 9 feet.

The original project of 1827 was to deepen by jetties the channel through the shoals in the 8 miles next below Wilmington. This project resulted in a gain of 2 feet available depth. The project of 1853 was to straighten and deepen the bar channel by dredging, jettying, diverting flow from the New Inlet, and closing breaches in Zekes Island. This project was incomplete when the civil war began.

After the civil war the first project was that of 1870, to deepen the bar channel by closing breaches between Smiths and Zekes islands, with the ultimate closure of New Inlet in view. The project of 1873 included that of 1870, and in addition the dredging of the bar channel and closing of New Inlet. The project of 1874 was to obtain by dredging a channel 100 feet wide and 12 feet deep at low water up to Wilmington. The project of 1881 was to obtain by dredging a channel 270 feet wide and 16 feet deep at low water up to Wilmington. These projects had been practically completed in 1889.

The existing project, dated February 28, 1889 (see Annual Report of Chief of Engineers for 1889, p. 1132), is to obtain a mean low-water depth of 20 feet and a width of 270 feet from Wilmington to the ocean, at an estimated cost of \$1,800,000. This project was modified by act of June 13, 1902, to authorize the construction of mooring dolphins at Wilmington at a cost of \$30,000, and to provide for the removal of obstructions at mouth of Brunswick River, at an estimated cost of \$1,000. The project was modified by the river and harbor act of March 2, 1907, which provides for continuing improvement in accordance with report submitted in House Document No. 545, Fifty-ninth Congress, first session, for completion of the 20-foot project to the projected width, by dredging and the excavation of a mooring basin in lieu of constructing mooring dolphins at Wilmington, involving a reduction of the estimate of cost to \$1,392,750, including removal of obstructions at mouth of Brunswick River. Work on this project is about 80 per cent completed. The act also authorizes improvement to such depth in excess of 20 feet as appropriations for the work may permit, due regard being given to the difference in tidal oscillation at the upper and lower portions of the improvement, and authorizes so much as may be necessary of the funds available to be applied to repairing the New Inlet and Swash Defense dams. The cost of these repairs is estimated at \$165,000. Annual maintenance is estimated to cost \$65,000.

The river and harbor act of March 3, 1905, appropriated \$150,000 for continuing the improvement, and authorized an additional expenditure of \$300,000 under continuing contract, all of which has now been appropriated.

The river and harbor act of March 2, 1907, appropriated the sum of \$165,000 for improvement, and authorized an additional expenditure of \$250,000, yet to be appropriated.

No contracts for improvement have yet been made.

## EXPENDITURES.

Prior to civil war (including balance transferred)	\$363, 228. 92
Since civil war on prior projects	2, 102, 271. 93
On existing project to June 30, 1907:	
For improvement	\$1, 032, 425. 48
For maintenance	337, 729. 45
	<hr/> 1, 370, 154. 93
Total	3, 835, 655. 78

The work of improvement consisted of the following:

(a) Widening the dredged cuts in the river, as follows:

- 5,700 linear feet, width increased from 259 to 270 feet.
- 7,000 linear feet, width increased from 148 to 270 feet.
- 1,500 linear feet, width increased from 148 to 240 feet.
- 4,000 linear feet, width increased from 185 to 270 feet.

(b) The repairs to New Inlet and Swash Defense dams, which were in progress at the close of the fiscal year 1906, were continued until September 17, 1906, when a storm of extreme violence very materially injured both dams throughout their entire length, and wholly destroyed Swash Defense dam in several places, destroying work previously done to a very great degree.

Prior to the storm 800 feet of the New Inlet and 3,351 feet of the Swash Defense dams had been repaired and capped with concrete above about half tide, and the extension across Zekes Island repaired.

From the effects of the storm of September 17, 1906, which were closely observed, it was evident that the flow of water over the dam from the sea side dislodged the stones at the toe of the concrete slope on the river side, carried them to a position of equilibrium and piled them up by the weir action, which at the same time scooped out the mud and sand, leaving a trough between the dam and ridge of dislodged stone. This dislodged stone was replaced and the dredge *Ajæx* has since the storm filled in 8,600 feet of the trough which was washed between the toe of the wall and the ridge of dislodged stone.

The conditions on the shoals and bar at mean low water at the end of the fiscal year are shown by the following table:

Name of shoal.	Distance below Wilmington.	Length.	Depth.	Width.
	<i>Miles.</i>	<i>Fect.</i>	<i>Fect.</i>	<i>Fect.</i>
Wilmington shoal .....		3,200	20	270
Alligator Creek shoal .....	1.5	9,800	20	259
Brunswick River shoal .....	3.0	8,600	20	259
Logs and Big Island shoal .....	7.0	16,700	20	270
Keg Island shoal .....	9.5	4,000	20	270
Lilliput shoal .....	11.0	17,200	20	259
Old Brunswick Cove shoal .....	13.5	5,000	20	259
Midnight shoal .....	16.0	14,500	20	148
Reaves Point shoal .....	19.0	2,000	a 20	240-270
Snows Marsh shoal .....	20.0	9,600	18-20	b 150
Ocean Bar shoal .....	30.0	6,000	c 20	300

<sup>a</sup> 20 feet deep and 270 feet wide for 500 feet of its length and 20 feet deep and 240 feet wide for the remaining 1,500 feet of its length.

<sup>b</sup> 18 to 20 feet deep. The 18-foot channel is about 150 feet wide at the narrowest place, which is near the lower end.

<sup>c</sup> 20 feet deep (project depth) and 300 feet wide at the narrowest place. This channel is not straight. There is a narrow channel through the center of 22 feet.

The total results obtained on the project up to the end of the fiscal year may be summarized as follows:

At the ocean bar a 20-foot mean low-water channel exists from deep water inside to deep water outside, the width being 300 feet. There is a narrower channel through the center 22 feet in depth, and with the exception of a very short distance on the outer crest of the bar a depth of 24 feet can be carried across the bar at low tide.

From the ocean bar to Wilmington there is a 20-foot mean low-water channel, with a least width of 148 feet, except through Snows Marsh channel, where the depth is 18 to 20 feet, with a narrow central depth of 20 feet through most of its length. About one-half of the total length of the dredged channel has a minimum width of 259 feet.

The distance from the ocean bar to Wilmington is 30 miles, and the river is navigable 115 miles farther up to Fayetteville, the head of navigation.

The additional work proposed with funds on hand and the additional sum requested is toward the completion of the existing project and maintenance both during the progress of the improvement and after its completion.

The commerce of the year 1906 amounted to 814,291 tons, valued at \$42,684,315.75, which shows a loss in volume, as compared with 1905, of 56,815 tons, of the value of \$6,538,991.25. This decrease is due principally to the falling off in the exporting of cotton and lumber, and in the receipts of coal.

The commerce consisted principally of cotton, cotton-seed meal, naval stores, manufactured lumber, shingles, fertilizers, fertilizer material, coal, gum logs, cross ties, and general merchandise.

The increase from 220,000 tons in 1869 is due to the improvement of the river.

As a result of the improvement, vessels coming to Wilmington are much larger than formerly, the average tonnage in 1886 being 421, while in 1905 the average was 1,103. This increase in tonnage has caused a corresponding decrease in freight rates on shipments by water.

References: For special descriptions, see Annual Reports of the Chief of Engineers for 1873, page 44; 1887, page 1047; 1895, page 1335; 1896, page 1131, and 1901, page 1552. For reference to report on examination with a view to determining whether any modifications in the improvement are desirable, see House Document 545, Fifty-ninth Congress, first session.

July 1, 1906, balance unexpended.....	\$239, 779. 39
Amount appropriated by river and harbor act approved March 2, 1907.....	165, 000. 00
Amount appropriated by sundry civil act approved March 4, 1907....	100, 000. 00
Amount received from sales, rents, and refundments.....	6, 401. 76
	<hr/> 511, 181. 15

June 30, 1907, amount expended during fiscal year:

For works of improvement.....	\$94, 633. 43
For maintenance of improvement.....	41, 651. 00
	<hr/> 136, 284. 43

July 1, 1907, balance unexpended.....	374, 896. 72
July 1, 1907, outstanding liabilities.....	29, 115. 38

July 1, 1907, balance available.....	<hr/> 345, 781. 34
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July 1, 1907, amount covered by uncompleted contracts.....	53, 137. 50
Amount (estimated) required for completion of existing project....	<hr/> 350, 000. 00

{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907.....	250, 000. 00	
		Submitted in compliance with requirements of sundry civil act of June 4, 1897.

(See Appendix M 12.)

13. *Shallotte River, North Carolina.*—At present the channel depth on the ocean bar is about 3 feet at low water and  $7\frac{1}{2}$  feet at high water. From the bar to a point  $2\frac{1}{4}$  miles above there is a 5-foot low-water channel; the next  $1\frac{3}{4}$  miles is badly obstructed by mud flats and oyster rocks, over which there is about 1 foot depth at low water. From this point to the town of Shallotte, 8 miles farther up, the river is narrow and crooked and the low-water depth varies from 2 to 12 feet.

Act of Congress approved March 2, 1907, appropriated \$3,000 to be expended on this river. This appropriation not being based on

any previous project, the project submitted to and approved by the Chief of Engineers for the expenditure of the funds available becomes the project.

The present project is to dredge a channel 35 feet wide and 4 feet deep at low water, following the best water along the western shore, between a point  $2\frac{1}{2}$  miles above the inlet and a point 4 miles above the inlet.

Active work of improvement has not yet been begun.

Amount expended on existing project to June 30, 1907: For improvement. \$49. 20

The expenditures during the year were for making an examination to collect data upon which to base a project for the expenditure of the available funds.

The river is tidal, there being a rise and fall of tide of approximately 3 feet at the town of Shallotte, which is the head of schooner navigation.

It is proposed to expend the funds available, as outlined in the present project.

The commerce is small, probably amounting to 10,000 tons, valued at approximately \$75,000. It was found impracticable in the limited time between the date of the appropriation and the end of the fiscal year to obtain reliable commercial statistics. The captains of the craft plying this river are usually part owners of the boats, and it is difficult to obtain data, owing to the fact that records of the business done is kept by memoranda.

The effect of the proposed improvement on freight rates is not known.

Reference is made to the Annual Report of the Chief of Engineers for 1890, page 1184, and to House Document No. 146, Fifty-ninth Congress, first session, for reports of examinations and surveys of the locality.

Amount appropriated by river and harbor act approved March 2, 1907.	\$3,000. 00
June 30, 1907, amount expended during fiscal year, for works of improvement	49. 20

July 1, 1907, balance unexpended	2,950. 80
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(See Appendix M 13.)

14. *Removing sunken vessels or craft obstructing or endangering navigation.*—An allotment was made from this appropriation April 15, 1907, for removing the wreck of the schooner *R. D. Bateman* from Smith Creek near Oriental, N. C.

This wreck was removed and reported on under date of June 28, 1907, at a cost of \$116.24.

#### EXAMINATION AND SURVEY MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF MARCH 3, 1905.

Reports dated November 21, 1905, and December 4, 1906, on preliminary examination and survey required by the river and harbor act approved March 3, 1905, of Pamlico and Tar rivers, with a view to obtaining a depth of 10 feet below Washington, and 4 feet above as far as Greenville, with suitable widths, were submitted by the district officer and were reviewed by the Board of Engineers for

Rivers and Harbors, pursuant to law. They were transmitted to Congress and printed in House Document No. 342, Fifty-ninth Congress, second session. A plan for improvement at an estimated cost of \$3,800, and \$1,000 annually for maintenance, is submitted.

IMPROVEMENT OF WACCAMAW RIVER, NORTH CAROLINA AND SOUTH CAROLINA, AND OF CERTAIN RIVERS AND HARBORS IN SOUTH CAROLINA.

This district was in the charge of Capt. G. P. Howell, Corps of Engineers. Division engineer, Lieut. Col. Dan C. Kingman, Corps of Engineers.

*1. Waccamaw River, North Carolina and South Carolina, and Little Pedee River, South Carolina.*—(a) *Waccamaw River.*—In 1880 this stream was navigable for 12-foot-draft boats at all stages of water from Georgetown, 23 miles, to Bull Creek, and at high water 4 miles farther, to Bucks lower mills; thence for 7-foot-draft boats, at high water, 22 miles farther, to Conway; thence it possessed an obstructed channel for 3-foot-draft boats, at ordinary winter water, 68 miles, to Reeves Ferry; thence an obstructed channel, with 3 feet at high water, for 30 miles, to Lake Waccamaw.

The project of improvement, adopted in 1880, provides for a channel 12 feet deep at all stages of water, with 80 feet bottom width from the mouth of the river to Conway, thence a cleared channel to Lake Waccamaw.

The original estimated cost was \$29,370, which was revised in 1885 and increased in the Annual Report of that year to the present figure, \$138,400. In the Annual Report of the Chief of Engineers for 1886, page 170, maintenance is estimated at \$4,000 per year after completion of improvement.

The total expenditure to June 30, 1907, was \$128,267.78. The river had been cleared of snags to a distance of 128 miles above the mouth, and this portion of the river had been frequently resnagged as appropriations permitted, 46,201 snags, etc., having been removed since June 30, 1884. Some work had been done toward increasing the original depth on eight shoals below Conway. As nearly as could be determined from the records, about \$75,977.81 had been expended in originally snagging the lower 128 miles of the river and in constructing pile and plank dikes at eight shoals, and \$35,435.11 in maintenance. The expenditure for maintenance during the year was for resnagging the upper portion of the river. There were removed from the banks 892 trees and 102 cords of brush; from the channel, 374 logs, 34 stumps, and 660 snags.

Dredging was begun in 1903, to obtain a 6-foot channel below Conway and to straighten the river by cutting through the worst bends. The number of cubic yards thus removed is 94,703.

The approved project is about 81 per cent completed.

The available depths reported as now existing do not differ greatly from the original depths. At mean low water about 12 feet can be carried to Bucksville, 34 miles above the mouth; 6 feet to Conway, 50 miles; about 2 feet to Wortham's bridge, 97 miles. At high water large side-wheelers can go to Red Bluff, 74 miles, and small boats to Reeves Ferry, 117 miles. The usual variation in water level is about



7.5 feet at Conway, 50 miles above the mouth, and about 12 feet at Star Bluff, 84 miles above the mouth.

The tidal influence at low water extends 97 miles above the mouth.

*Commercial statistics.*

Year.	Total tons.	Value.	Year.	Total tons.	Value.
1887.....		\$2, 129, 231.75	1895.....	258, 191	\$2, 666, 280.00
1889.....		2, 308, 915.00	1899.....	376, 822	3, 135, 214.00
1890.....	67, 195	2, 317, 368.50	1900.....	467, 87	3, 481, 072.00
1891.....	76, 245	2, 231, 112.00	1901.....	302, 655	3, 885, 700.00
1892.....	83, 103	2, 178, 369.00	1902.....	141, 686	1, 844, 019.00
1893.....	70, 976	2, 095, 548.00	1903.....	143, 813	1, 884, 700.00
1894.....	99, 298	2, 120, 864.00	1904.....	190, 435	2, 119, 040.00
1895.....	128, 466	2, 063, 697.00	1905.....	207, 630	2, 665, 917.00
1896.....	203, 388	2, 314, 175.00	1906.....	244, 920	3, 720, 000.00
1897.....	241, 300	2, 406, 390.00			

Prior to the year 1902 the commerce on the Great Pedee River has been included, as it is carried over the lower 22 miles of the Waccamaw River to get to Georgetown.

The vessels engaged in traffic on this river are steamers and tug-boats of from 10 to 550 tons, seagoing schooners of from 300 to 500 tons, pole boats, rafts, etc. The additional work proposed is necessary to make the improvement available.

No new line of transportation was established during the year.

For references to examinations and surveys see page 246, Annual Report of the Chief of Engineers, 1904.

It has been found impossible to obtain information concerning the effect of the improvement on freight rates.

July 1, 1906, balance unexpended.....	\$5, 938. 23
Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	18, 000. 00
	<hr/> 23, 938. 23
June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$7, 206. 17
For maintenance of improvement.....	1, 299. 84
	<hr/> 8, 506. 01

July 1, 1907, balance unexpended.....	15, 432. 22
July 1, 1907, outstanding liabilities.....	1, 863. 69
	<hr/> 13, 568. 53

Amount (estimated) required for completion of existing project.... 28, 800. 00

(b) *Little Pedee River.*—The river in its original condition was much obstructed by snags and overhanging trees and by 10 bridges without draws. In places it was divided into several branches, in none of which was there a good channel.

Under the plan of improvement adopted in 1888 it is proposed to snag the river and close unnecessary branches, providing for steamboat navigation up to the mouth of Lumber River, 65 miles, and for pole-boat navigation 48 miles farther, to Little Rock, at an estimated cost of \$50,000.

The total expenditures to June 30, 1907, were \$25,053.01. The river had been well snagged up to the mouth of Lumber River and

roughly cleared for pole-boat navigation to Little Rock. No work had been done toward increasing the original depths. As nearly as could be determined from the records, about \$19,549.99 had been expended in originally snagging the river, and about \$5,503.02 in maintenance.

All the expenditures during the fiscal year were for maintenance. From the channel 1,180 obstructions and from the banks 241 trees and 57 cords of brush were removed. Aggregate amount of obstructions removed since beginning of the improvement in 1888 is 31,718.

About 50 per cent of the approved project has been accomplished up to June 30, 1907. The available depths now existing do not probably differ greatly from the original depths. No permanent improvement can be effected toward increasing the maximum draft over the shoals without considerable dredging, which was not provided for in the original project. The usual variation in water level at Gilchrist bridge, about 65.5 miles above the mouth, is about 9.5 feet.

*Commercial statistics.*

Year.	Total tons.	Value.	Year.	Total tons.	Value.
1891.....	4,614	\$52,760	1899.....	16,685	\$144,787
1892.....	7,115	92,964	1900.....	23,780	173,500
1893.....	6,153	101,585	1901.....	51,430	399,000
1894.....	8,375	114,600	1902.....	57,050	416,000
1895.....	12,438	117,470	1903.....	77,750	560,500
1896.....	17,050	198,500	1904.....	83,100	645,000
1897.....	13,182	100,400	1905.....	87,985	663,650
1898.....	11,900	105,750	1906.....	18,880	389,500

Vessels ply on the river as far as Gallivant's bridge, 47 miles above its mouth; the river is probably navigable at its mean low-water stage for boats with 3-foot draft as far as Gallivant's bridge. No new line of transportation was established during the year.

The balance on hand will be spent in maintaining the channel.

For outline map of river see page 1214, Annual Report of the Chief of Engineers for 1890. For preliminary examination and survey see page 1111, Annual Report of the Chief of Engineers for 1887.

It has been found impossible to obtain information as to the effect of the improvement on freight rates.

July 1, 1906, balance unexpended.....	\$313.52
Amount allotted from appropriation by river and harbor act approved	
March 2, 1907.....	2,000.00
	2,313.52
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	666.53
July 1, 1907, balance unexpended.....	1,646.99
Amount (estimated) required for completion of existing project....	30,450.00

## CONSOLIDATED.

July 1, 1906, balance unexpended-----	\$6,251.75
Amount appropriated by river and harbor act approved March 2, 1907-----	20,000.00
	<hr/> 26,251.75
June 30, 1907, amount expended during fiscal year:	
For works of improvement-----	\$7,206.17
For maintenance of improvement-----	1,966.37
	<hr/> 9,172.54
July 1, 1907, balance unexpended-----	17,079.21
July 1, 1907, outstanding liabilities-----	1,863.69
	<hr/>
July 1, 1907, balance available-----	15,215.52
Amount (estimated) required for completion of existing project----	59,250.00
(See Appendix N 1.)	

2. *Lynch River and Clark Creek, South Carolina.*—Lynch River is a tributary of the Great Pedee River, into which it flows a few miles above Smiths Mills at a point about 65 miles above the mouth of the Great Pedee River. Shortly above this point a branch of Lynch River, known as Clark Creek, leaves it, and, flowing about 7 miles, empties into the Great Pedee River about 10½ miles below the mouth of Lynch River. The mouth of Lynch River was completely filled with drift coming in from the Great Pedee River, thus forcing all traffic to come down Clark Creek. Its upper end was also choked by this drift.

The project of improvement adopted in 1888 provided for roughly clearing a channel in Clark Creek, to afford an outlet for Lynch River. The estimated cost was \$7,500. The money was appropriated from 1888 to 1892, inclusive, and was expended in roughly clearing a channel 40 feet wide and 3 feet deep. As no further appropriations were made, the channel filled up and no permanent improvement was effected.

The river and harbor act of March 2, 1907, appropriated \$2,000 for improving Lynch River and Clark Creek by the removal of logs and snags. The adopted project provides for removing obstructions, as far as the funds will permit, to permit the passage of rafts through the lower end of Clark Creek through a small connecting stream between Clark Creek and Lynch River, known as Lawrence Cut, and through Lynch River. The expenditures during the year were \$144.58, and were for the purpose of preparing plant to work on the stream.

Commercial statistics: 1906, outward freights: Logs, 3,552 tons, valued at \$13,000.

There is no other commerce on this stream.

There is no navigation save by rafts.

For map of Clark Creek, see page 1204, Annual Report of the Chief of Engineers, 1890. For reports of examinations of Lynch River, see Annual Reports of the Chief of Engineers for 1881, page 1038; 1893, page 1532, and 1900, page 1877.

Amount appropriated by river and harbor act approved March 2, 1907— \$2,000.00  
 June 30, 1907, amount expended during fiscal year, for works of improvement ----- 144.58

July 1, 1907, balance unexpended ----- 1,855.42  
 July 1, 1907, outstanding liabilities ----- 278.50

July 1, 1907, balance available ----- 1,576.92

(See Appendix N 2.)

3. *Great Pedee River, South Carolina.*—The river in its original condition was dangerously obstructed by logs everywhere. Boats drawing 9 feet of water were able to reach Smiths Mills, 52 miles above the mouth. Those drawing  $3\frac{1}{2}$  feet could get 54 miles farther up at low water to Little Bluff, or at high water to Cheraw, 167 miles from the mouth.

The project of improvement adopted in 1880 provides for a thoroughly cleared 9-foot navigation to Smiths Mills and a  $3\frac{1}{2}$ -foot navigation to Cheraw at all stages of water.

The original project contained no estimate of cost. From 1880 to 1886, inclusive, \$47,000 was appropriated. In the Annual Report of the Chief of Engineers for 1886, page 170, it was estimated that \$70,000 in addition to this \$47,000 would complete the improvement, and that \$5,000 a year would be required for maintenance.

A project for the improvement of the upper river (the 64 miles between Cheraw and the bridge of the Wilmington, Columbia and Augusta Railroad) was adopted in 1902. (See Annual Report of the Chief of Engineers for 1901, p. 1607.) This project provides for obtaining, by snagging and dredging, a cleared channel, with a least depth of  $3\frac{1}{2}$  feet at mean low water, at a cost of \$118,300; and the work was placed in the continuing-contract class. A total of \$107,000 has been appropriated; \$11,300 remains to be appropriated.

The total expenditures to June 30, 1907, were \$183,512.19. Of this amount the sum of 28 cents was received on account of refundment of overpayment. The river had been well cleared of snags from the mouth to the Wilmington, Columbia and Augusta Railroad bridge, 103 miles, and less thoroughly snagged between the bridge and Cheraw, 40,918 snags, etc., having been removed since June 30, 1884.

As nearly as could be determined by the records, about \$78,919.13 had been expended in originally clearing the river of snags and in preliminary examination and survey made in 1900, and about \$42,073.20 in maintenance. The expenditures for maintenance during the year were for office expenses.

About 40 per cent of the approved project for the upper river has been completed up to June 30, 1907. The contemplated depth ( $3\frac{1}{2}$  feet) has been attained at five of the shoals at the upper end of the stretch.

At mean low water 8 feet can be carried to Smiths Mills, 52 miles above the mouth; about 3 feet to the Wilmington, Columbia and Augusta Railroad bridge, 103 miles above, and about 2 feet to Cheraw, the head of navigation, 167 miles above.

The usual variation in water level is 16.4 feet at Smiths Mills and 34.2 feet at Cheraw.

*Commercial statistics.*

Year.	Total tons.	Value.	Year.	Total tons.	Value.
1891.....	62,344	\$1,367,330	1899.....	134,072	\$1,692,709
1892.....	92,471	1,401,038	1900.....	154,727	2,645,560
1893.....	94,661	1,166,874	1901.....	188,912	2,811,080
1894.....	91,025	1,169,070	1902.....	152,008	1,328,970
1895.....	106,115	893,430	1903.....	153,014	1,338,759
1896.....	229,964	1,825,250	1904.....	162,566	1,507,181
1897.....	114,177	1,167,914	1905.....	148,869	1,618,551
1898.....	75,280	1,228,885	1906.....	175,250	1,751,475

The vessels engaged in traffic on this river are steamers of 400 tons and less, seagoing schooners, pole boats, rafts, etc. No new line of transportation has been established during the year, but as a result of the dredging operations now in progress a new company has been organized to put on a line of steamers between Georgetown and Cheraw.

For references to examinations and surveys, see page 249, Annual Report of the Chief of Engineers for 1904.

It has been found impossible to obtain information as to the effect of the improvement on freight rates.

July 1, 1906, balance unexpended.....	\$39,998.19
Amount appropriated by river and harbor act approved March 2, 1907.....	20,000.00
Amount appropriated by sundry civil act approved March 4, 1907.....	30,000.00
Received account refund of overpayment.....	.28
	<hr/> 89,998.47

June 30, 1907, amount expended during fiscal year:

For works of improvement.....	\$19,195.78
For maintenance of improvement.....	314.60
	<hr/> 19,510.38

July 1, 1907, balance unexpended.....	70,488.09
July 1, 1907, outstanding liabilities.....	2,334.45

July 1, 1907, balance available.....	<hr/> 68,153.64
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Amount (estimated) required for completion of existing project....	11,300.00
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(See Appendix N 3.)

4. *Winyah Bay, South Carolina.*—This large bay is connected with the ocean by a passage between the shores of North and South islands  $2\frac{1}{2}$  miles long, 1 mile wide at the bay, three-fourths mile wide at the gorge, and  $1\frac{1}{4}$  miles wide at the ocean, or southeasterly end of North Island. Through the passage, which trends north-northwest and south-southeast, there was a bold channel 36 feet deep at the bay, retaining a depth of not less than 20 feet until about 3,000 feet southerly from the end of North Island and of not less than 15 feet to a point about 1 mile south of the island, where the channel divided into two. One of these two channels, known as Main channel, continued  $3\frac{1}{4}$  miles farther, through extensive shoals, to the 18-foot contour in the ocean. This channel was south-southeast and in alignment with the main channel through the straits. The other, known as Bottle channel, after flowing about 2,500 feet southeasterly, 1,500 feet easterly, and about 3,000 feet northeasterly, reached the 18-foot contour in the ocean at a distance of about  $1\frac{1}{2}$  miles in a direction from the point of

separation from the main ship channel almost at right angles with the direction of that channel and of the channel through the passage. At mean low water the depth on the crest of the bar was variable in both channels and about 7 to 9 feet in Main channel and 6 to 8 feet in Bottle channel. The mean range of tide is  $3\frac{1}{2}$  feet.

The present project, adopted in 1889, provides for the construction of two jetties, springing, respectively, from North and South islands and converging toward the bar, the jetties to consist of mattress foundation and a superstructure of large riprap stone raised to a height of 6 feet above mean low water, the south jetty to extend due east across the bar and the north jetty to converge toward it, so as to produce the necessary contraction on the bar. The depth to be secured is 15 feet at mean low water. The river and harbor act of June 3, 1896, authorized the completion of the work under continuing-contract system, at a cost not exceeding \$1,996,250, in addition to the \$20,000 appropriated by the act. The entire amount has been appropriated by sundry civil acts since that date. The project was extended by the river and harbor act approved June 13, 1902, to permit dredging at the shoal places in Winyah Bay, between the entrance and the city of Georgetown, S. C., over which the least channel depths might at any time be less than at the entrance to the bay, provided that the expenses of this dredging, added to that of improving the entrance to the bay, should not exceed the total amount authorized under the continuing-contract system.

The total expenditures to June 30, 1907, were \$2,371,902.98, of which \$428,750 was appropriated prior to June 3, 1896. Of this amount \$6,247.74 was derived from miscellaneous sources, such as rent of dredge, auction sales, etc. For maintenance \$40,132.99 has been spent. The jetty work, which since June 3, 1896, had been under a continuing contract, had been completed. The north jetty extends a distance of 11,139 feet from the shore end, with crest from  $4\frac{1}{2}$  to 6 feet above mean low water, except the outer 100 feet, which is submerged. The south jetty extends a distance of 21,051 feet from the shore end, with crest at heights varying from 10 feet above mean low water at the inner end to nothing at the outer end. The stone superstructure has practically no top width. A stone mound, 50 feet long, 30 feet wide, and 12 feet above low water had been constructed to mark the outer end of the south jetty. The seagoing suction dredge *Winyah Bay* has been built, and this dredge and the similar dredge *Charleston* have removed 1,510,362 cubic yards of material from the entrance channel and 827,074 cubic yards of material from the eastern channel in upper Winyah Bay and Sampit River shoal. Spur dikes have been built to protect the South Island beach. A mud dike has been built from the high land on South Island to the high land near the Santee River to prevent the tides from cutting around the shore end of the south jetty, and the stonework of the jetty has been extended about 2,600 feet by a work of sheet piling covered with mud to connect with this dike. The expenditure for maintenance during the year was for raising the low places in the mud dike, for sodding it, and for constructing the mound on the south jetty.

About 95 per cent of the approved project has been completed up to June 30, 1907. There is a channel between the jetties 15 feet deep at mean low water and 400 feet wide, though it is generally 500 feet

wide. In the upper bay the channel is 15 feet deep and in the entrance to the city of Georgetown the channel is 13 feet deep. This channel will be dredged to 15 feet at an early date. Very little additional work is required to obtain an 18-foot channel between the jetties. The mean range of tide is  $3\frac{1}{2}$  feet.

*Commercial statistics.*

Year.	Total tons.	Value.	Year.	Total tons.	Value.
1891.....	261,370	\$8,071,600	1900.....	129,639	\$6,749,433
1892.....	271,986	.....	1901.....	247,989	8,457,906
1893.....	268,640	.....	1902.....	387,471	9,310,682
1894.....	293,822	.....	1903.....	368,502	9,359,581
1896.....	171,059	6,228,350	1904.....	369,774	9,546,843
1897.....	149,374	5,817,950	1905.....	363,916	10,401,879
1898.....	125,003	5,587,880	1906.....	392,770	10,139,751
1899.....	120,587	6,337,853			

The vessels using the entrance channel are steamers of 1,850 tons and less and sailing vessels of various kinds. The freight carried is principally lumber, naval stores, and general merchandise. There are three lines of steamships plying between Georgetown and northern ports. The water rate on lumber, the chief export, had decreased from \$5.50 per thousand feet B. M. in 1892 to \$4.12 $\frac{1}{2}$  in 1905, but during the present year it has advanced to \$6, owing to the great number of vessels of this tonnage lost in the storms during the year.

For references to examinations and surveys see page 250, Annual Report of the Chief of Engineers for 1904.

July 1, 1906, balance unexpended.....	\$118,418.29
Amount appropriated by river and harbor act approved March 2, 1907.....	30,000.00
Amount appropriated by sundry civil act approved March 4, 1907....	72,750.00
Received account sales at auction.....	463.38
	<hr/> 221,631.67

June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$71,940.59
For maintenance of improvement.....	30,346.32
	<hr/> 102,286.91

July 1, 1907, balance unexpended.....	119,344.76
July 1, 1907, outstanding liabilities.....	8,452.86
	<hr/>

July 1, 1907, balance available.....	110,891.90
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(See Appendix N 4.)

5. *Mingo Creek, South Carolina.*—To June 30, 1897, \$17,000 had been expended on improvement to provide steamboat navigation up to Williams Landing and pole-boat navigation at high water up to the head of navigation by snagging and clearing the banks.

Deterioration having occurred, the sum of \$300 had been allotted from the emergency appropriation provided by the river and harbor act of March 3, 1905, to be applied to removal of obstructions and overhanging trees. The sum of \$177.69 was spent during the fiscal year 1906 for removing the obstructions that most seriously interfered with navigation, and during the present fiscal year the balance of \$122.31 was expended for the same purpose.

July 1, 1906, balance unexpended.....	\$122. 31
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	122. 31

(See Appendix N 5.)

6. *Santee, Wateree, and Congaree rivers, and Estherville-Minim Creek Canal, South Carolina.*—(a) *Santee River and Estherville-Minim Creek Canal.*—This river in its original condition was considerably obstructed at all stages of water by sunken logs and snags. Its bar entrance was narrow, crooked, and shifting, with only about 4 feet of water at low tide, and so situated as to be difficult and expensive to improve.

The original project, adopted in 1880, contemplated providing an outlet for the river into Winyah Bay by constructing a canal from the river through Mosquito Creek into the bay. On this project there was expended \$99,750.

The present project, adopted in 1889, contemplates providing a more satisfactory outlet into the bay by cutting a canal 70 feet wide and 6 feet deep at mean low water from the Estherville plantation to Minim Creek and for snagging the entire river. The estimated cost is \$350,000, not including the amount expended under the original project.

The total expenditures under the present project to June 30, 1907, were \$211,147.86, of which about \$38,962.54 was for maintenance; of this \$32.50 was derived from sales at auction, etc. All the expenditure during the year was for maintenance, and consisted in dredging the canal, constructing a snag boat, and general work. The first cut of the canal had been made entirely through, and this had been widened through a portion of its length. From the Santee River proper 1,809 obstructions had been removed.

The approved project is about 84 per cent completed.

Except at the Winyah Bay end, where on account of the softness of the banks the width has been reduced to 40 feet, the canal is 50 feet wide and 6 feet deep. The mean rise of tide at the canal is about  $3\frac{1}{2}$  feet. The least available depth in Santee River is about 4 feet at low water. The usual variation in water level at the Atlantic Coast Line bridge, about  $54\frac{1}{2}$  miles above the mouth, is about 19 feet, and at its junction with the Wateree and Congaree rivers, 143 miles above the mouth, about 20 feet. The river is navigable its entire length.

#### Commercial statistics.

Year.	Total tons.	Value.	Year.	Total tons.	Value.
1891.....	100,255	\$2,743,000	1899.....	154,327	\$2,679,100
1892.....	110,523	2,775,800	1900.....	179,090	2,622,200
1893.....	124,182	2,679,600	1901.....	204,375	1,809,000
1894.....	115,428	2,375,000	1902.....	215,600	1,882,500
1895.....	117,690	2,224,800	1903.....	220,900	1,840,000
1896.....	134,135	2,204,600	1904.....	242,800	1,662,500
1897.....	134,206	2,159,940	1905.....	329,350	1,485,000
1898.....	112,205	2,203,800	1906.....	427,300	1,880,000

The vessels using the river and canal are steamers of from 10 to 500 tons, small sailing craft, pole boats, rafts, etc.



The additional work proposed is necessary to make the improvements available and for extending the benefits.

For references to examination and surveys and other information concerning the work see page 252, Annual Report of the Chief of Engineers, 1904.

It has been found impossible to obtain information as to the effect of the improvement on freight rates.

July 1, 1906, balance unexpended.....	\$18, 227. 51
Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	33, 000. 00
	<hr/> 51, 227. 51
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	14, 342. 87
July 1, 1907, balance unexpended.....	36, 844. 64
July 1, 1907, outstanding liabilities.....	626. 50
	<hr/> 36, 258. 14
Amount (estimated) required for completion of existing project.....	109, 000. 00

(b) *Wateree River*.—In its original condition this stream had a low-water depth of from 3 to 4 feet from its mouth, 67 miles, to Camden. The lower 14 miles was completely blocked at all stages of water by logs, snags, etc., and at moderate stages by the bridges of the South Carolina and the Wilmington, Columbia and Augusta railroads, then without draw spans; thence to Camden navigation was possible, but dangerous, except during high water. Its commerce was practically nothing.

The present project of improvement, adopted in 1881, provides for safe and unobstructed 4-foot navigation for steamers from Camden to the mouth, at an estimated cost of \$60,000.

The appropriation of September 19, 1890, completed the estimate for the project, but appropriations have since been made for maintenance. The work is one of snagging only, and as snags are continually lodging, it is not susceptible of completion. Snagging work should be done annually in order to keep the channel open.

The total expenditures to June 30, 1907, were \$89,972.36. To June 30, 1900, the river had been kept fairly clear of obstructions from the mouth to Camden. Work was suspended in 1899, and was resumed in May, 1907, a snag boat having been built for this stream. All the expenditures during the year were for maintenance; a snag boat was built and the following obstructions removed: From the banks, 249 trees and 10 cords of brush; from the channel, 101 logs, 178 stumps, and 1 cord of small snags.

So far as known the available depths now existing do not differ greatly from the original depths. The usual variation in water level is about 17 feet at a point about 4 miles above the mouth, and about 28.5 feet at Camden, 67 miles above the mouth.

*Commercial statistics.*

Year	Total tons.	Value.	Year.	Total tons.	Value.
1891.....	1,005	\$51,210	1899.....	109,170	\$272,200
1892.....	2,244	86,040	1900.....	98,024	155,000
1893.....	6,242	117,729	1901.....	10,417	50,000
1894.....	18,075	94,334	1902.....	42,575	92,500
1895.....	21,697	127,565	1903.....	41,050	87,000
1896.....	35,002	233,525	1904.....	15,600	29,700
1897.....	43,770	202,800	1905.....	22,000	41,000
1898.....	83,568	274,050	1906.....	16,200	81,000

Rafting is the only business done on this river. No new line of transportation was established during the year.

The additional work proposed is necessary to make the improvement available.

For references to examinations and surveys see page 253, Annual Report of the Chief of Engineers, 1904.

It has been found impossible to obtain information as to the effect of the improvement on freight rates.

July 1, 1906, balance unexpended..... \$21,912.38

Amount allotted from appropriation by river and harbor act approved March 2, 1907..... 50,000.00

71,912.38

June 30, 1907, amount expended during fiscal year, for maintenance of improvement..... 14,384.74

July 1, 1907, balance unexpended..... 57,527.64

July 1, 1907, outstanding liabilities..... 1,628.45

July 1, 1907, balance available..... 55,899.19

(c) *Congaree River*.—In 1886 this stream in its original condition had a low-water depth of 3 to 4 feet from its mouth to the railroad bridge at Columbia, thence 1 foot low-water depth 2 miles farther to its head. The navigation of the lower 49 miles was blocked at all stages of water by the South Carolina Railroad bridge and by sunken logs, snags, and overhanging trees. The navigation of the remaining 2 miles was prevented by swift currents and numerous rock ledges and bowlders. Its commerce was nothing.

The project of improvement adopted in 1886 proposes to secure a thoroughly cleared 4-foot navigation over the lower 49 miles at all stages of water and a cleared channel through the rock ledges and bowlders above at an estimated cost of \$54,500. This project was modified in 1899, when a lock and dam was authorized for extending steamboat navigation through these ledges and bowlders in the river from Gervais Street Bridge, Columbia, to Granby. The open-channel work above Granby was thus eliminated. Appropriations for the lock and dam were made, amounting to \$250,000, \$25,000 of which, by authority of Congress, was allotted for the open-channel work. The lock and dam had been completed with the \$225,000, and considerable work done in clearing the channel between the lock and the city of Columbia.

The river and harbor act of March 2, 1907, contained the following proviso in appropriating for this stream: "And the limits of the improvement of the Congaree River shall be extended to include

that part of the said river included in the project from Gervais Street Bridge, Columbia, to Granby, South Carolina." Under this authority the work on the entire length of the river will be prosecuted under allotments from appropriations for improving Santee, Wateree, and Congaree rivers, and the Estherville-Minim Creek Canal, South Carolina.

In 1905 a survey of the river between the lock and dam and the mouth of the river, made to determine what additional work was required to form a 4-foot channel at all stages of water, showed that in addition to clearing the river of obstructions by snagging, dredging was also required, and that the estimated cost of the project should be increased accordingly. To obtain and maintain this channel would cost \$20,000 a year for four years, after which a yearly expenditure of \$10,000 would probably suffice.

The total expenditures to June 30, 1907, were \$64,255.26, of which 50 cents was derived from refundment of overpayment. The channel had been thoroughly snagged from the mouth to Granby, 2 miles below Columbia. A total of 14,754 obstructions had been removed below Granby. Dredging had been carried on at Barbours Cut, removing 10,859 cubic yards of sand and pebbles. Work had been in progress of clearing the channel above the lock. As nearly as can be determined from the records, about \$19,523.82 had been expended in originally snagging the river and about \$26,097.11 in maintenance. During the fiscal year the expenditure for maintenance resulted in the removal of 2,378 obstructions from the stream.

So far as known the available depths now existing do not differ greatly from the original depths.

About 3 feet can be carried at mean low water to Granby, the present head of navigation. The usual variation in water level at a point 2 miles above the mouth is about 24.3 feet and at Columbia about 33.2 feet.

*Commercial statistics.*

Year.	Total tons.	Value.	Year.	Total tons.	Value.
1891.....	2,401	\$47,840	1899.....	88,696	\$191,700
1892.....	3,686	62,025	1900.....	121,368	197,000
1893.....	2,781	71,125	1901.....	14,588	70,000
1894.....	7,974	40,760	1902.....	58,075	123,500
1895.....	8,998	45,700	1903.....	114,310	271,400
1896.....	18,307	178,900	1904.....	43,035	93,900
1897.....	40,857	110,100	1905.....	34,350	252,000
1898.....	81,362	201,700	1906.....	35,522	821,100

A steamboat line between Columbia and Georgetown, S. C., has been established. Connection is made at Georgetown with steamers for New York, Baltimore, and Charleston. The channel above the lock has not yet been sufficiently cleared to permit its use by boats. A reduction of from 22 to 30 per cent in freight rates from Columbia to New York (difference between rail and water transportation) has been effected by the improvement.

For preliminary examination and survey, see page 1140, Annual Report of the Chief of Engineers for 1885. For outline map of river, see page 1194, Annual Report of the Chief of Engineers for 1889.

For project for construction of lock and dam, see page 1182, Annual Report of the Chief of Engineers for 1896.

July 1, 1906, balance unexpended.....	\$20, 297. 87
Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	67, 000. 00
	<hr/> 87, 297. 87
June 30, 1907, amount expended during fiscal year:	
For works of improvement .....	\$17, 463. 03
For maintenance of improvement.....	6, 089. 60
	<hr/> 23, 552. 63
July 1, 1907, balance unexpended.....	63, 745. 24
July 1, 1907, outstanding liabilities.....	5, 016. 19
	<hr/>
July 1, 1907, balance available .....	58, 729. 05

## CONSOLIDATED.

July 1, 1906, balance unexpended.....	\$60, 437. 76
Amount appropriated by river and harbor act approved March 2, 1907.....	150, 000. 00
	<hr/> 210, 437. 76
June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$17, 463. 03
For maintenance of improvement.....	34, 817. 21
	<hr/> 52, 280. 24
July 1, 1907, balance unexpended.....	158, 157. 52
July 1, 1907, outstanding liabilities .....	7, 271. 14
	<hr/>
July 1, 1907, balance available .....	150, 886. 38
	<hr/>
Amount (estimated) required for completion of existing project....	109, 000. 00

(See Appendix N 6.)

7. *Congaree River, South Carolina, from Gervais Street Bridge, Columbia, to Granby.*—For original condition of this portion of the river, see preceding report on Congaree River, South Carolina.

Pursuant to House resolution dated December 15, 1893, a project and estimate were submitted January 2, 1894, for extending steamboat navigation from Granby to Gervais Street Bridge, Columbia, by the construction of a lock and movable dam near Granby. This document and a letter concerning it are printed on pages 1182–1189, Annual Report of the Chief of Engineers for 1896.

The river and harbor act approved March 3, 1899, appropriated \$50,000 for beginning this work, and authorized continuing contracts to be made for its completion at a total cost not exceeding \$200,000 in addition to the \$50,000 appropriated. Three appropriations, aggregating \$200,000, have since been made for this work, completing the amount authorized by the act.

The river and harbor act approved March 3, 1905, appropriating for improving Santee, Wateree, and Congaree rivers and the Estherville-Minim Creek Canal, contained the provision:

The Secretary of War may expend upon such improvement the unexpended balance of the appropriation heretofore made for a lock and dam in the Congaree River provided for by the act of March third, eighteen hundred and ninety-nine.

The sum of \$25,000 has been allotted under this authority for the improvement of the Congaree River (open-channel work), thus reducing the amount available for the lock and dam to \$225,000.

The total expenditures to June 30, 1907, were \$225,000.14, of which 14 cents was received on account of overpayment. The lock and dam have been completed.

During the past year work has been in progress of clearing the channel above the lock of obstructions, mostly rock ledges and boulders. There is no navigation at present on this portion of the river. The usual range of water level at Columbia is about 33.2 feet.

July 1, 1906, balance unexpended.....	\$3, 761. 95
Received account of overpayment.....	. 14

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3, 762. 09

June 30, 1907, amount expended during fiscal year, for works of improvement .....	3, 762. 09
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(See Appendix N 7.)

8. *Operating and care of lock and dam across Congaree River, near Columbia, S. C.*—This service is provided for by the permanent indefinite appropriation for operating and care of canals and other works of navigation, under the provisions of section 4 of the river and harbor act of July 5, 1884.

The operation and care of the lock and dam across the Congaree River have been provided for by allotments from this appropriation since April 7, 1906. The expenditures during the fiscal year were \$4,618.73; the total expenditures have been \$5,500.

(See Appendix N 8.)

9. *Inland waterways between Charleston Harbor, South Carolina, and opposite McClellanville.*—These waterways consist of a series of creeks, sounds, rivers, and bays, which afford a route sheltered for the most part from the sea by the numerous islands which form the outer coast line. The route is tidal throughout, the range of tide varying from about 4.6 to 5.3 feet. It is now obstructed by a number of shallow reaches and narrow, crooked passages, particularly at points where the tides meet. The passage across Bulls Bay, besides being very shallow, is much exposed. The present commerce is comparatively small, as only very small vessels can get through without excessive delays.

The plan of improvement adopted in 1902 provides for a channel between Charleston Harbor and opposite McClellanville 4 feet deep at mean low water and 60 feet bottom width, at an estimated cost of \$125,290. The project was modified by the river and harbor act of March 2, 1907, to provide for a branch of the channel to Morrisons Landing in McClellanville. The new channel will partly follow the present channels and will partly lie in cuts across the marsh to avoid crooked and dangerous sections. It will pass to the northward of Bulls Bay.

The total expenditures to June 30, 1907, were \$17,848.88. A contract for dredging was let in 1905, and 57,363 cubic yards has been removed and paid for. About 12½ per cent of the approved project had been accomplished up to June 30, 1907.

The improvement can have no effect on freight rates until the project shall have been completed.

For references to reports of examinations and surveys, see page 256, Annual Report of the Chief of Engineers for 1904.

*Commercial statistics.*

Year.	Tons.	Value.
1903 .....	33,344	\$579,520
1904 .....	39,064	573,770
1905 .....	58,421	608,761
1906 .....		

July 1, 1906, balance unexpended..... \$41,800. 51  
 Amount appropriated by river and harbor act approved March 2, 1907- 75,290. 00

117,090. 51

June 30, 1907, amount expended during fiscal year, for works of improvement..... 9,649. 39

July 1, 1907, balance unexpended..... 107,441. 12

July 1, 1907, outstanding liabilities..... 1,253. 30

July 1, 1907, balance available..... 106,187. 82

July 1, 1907, amount covered by uncompleted contracts..... 32,227. 55

(See Appendix N 9.)

10. *Charleston Harbor, South Carolina.*—There were originally four channels across the bar, the deepest having about 12 feet depth at low water. Commerce was then using the Pumpkin Hill channel, about 3 miles south of the present jetty channel. Where the present jetty channel is situated there was then the Swash channel, with a best depth of 10½ feet of water, too crooked for safe use. The natural channels were shifting in position and variable in depth.

The original project, adopted in 1878, provided for establishing and maintaining, by means of two jetties and auxiliary dredging, a low-water channel of not less than 21 feet depth across the bar. The Swash channel was selected for improvement. The estimated cost was \$3,000,000.

In 1888 it became necessary to modify the height of the crest line of the jetties and to revise the estimate. This increase in the estimate was largely due to the fact that money had been appropriated so slowly that reasonable contract prices could not be obtained. The annual appropriation up to that time had been only 5½ per cent of the original estimate. In the revised project the jetties were increased in height and length, but no change was made in their position or distance apart. The revised estimates were \$4,380,500 if the jetties were brought up to low-water level throughout, and \$5,334,500 if brought up 3 feet higher. The former estimate was adopted by Congress in the river and harbor act approved July 13, 1892.

The present project, adopted by the river and harbor act approved March 3, 1899, provides for obtaining a channel at the entrance to Charleston Harbor not less than 26 feet deep at mean low water (mean range of tide about 5.2 feet) and 600 feet wide, by constructing a large seagoing suction dredge, at a cost of not exceeding \$150,000, and operating her, together with the existing dredge *Charleston*, for three years. The estimated cost of constructing the new dredge and operating it, as above, was \$285,000. Of this amount \$175,000 had been appropriated prior to the enactment of the river and harbor act of June 13, 1902, which made available an additional sum of \$208,000,

increasing to \$388,000 the amount authorized for the project for the new dredge and its operation. The entire amount authorized has been appropriated.

The total expenditures to June 30, 1907, were \$4,632,297.18, including about \$2,500 expended at Sullivans Island and \$10,000 at Mount Pleasant; of this sum, \$7,485.30 was derived from miscellaneous sources, such as rental of dredge, auction sales, etc. Of this amount, \$4,172,500 had been expended on the original project and on maintenance.

The project is completed, as the full depth of 26 feet at mean low water has been obtained and the full width of 600 feet, except for a short distance near the inner end of the jetties where the width is 550 feet. The mean tidal range is 5.2 feet.

The river and harbor act of March 3, 1905, authorizes the Secretary of War, in his discretion, to cause the new dredges employed on this work to be utilized, at such times as they are not employed in dredging on the outer bar, for dredging in the channels between said outer bar and the city of Charleston.

For references to examinations and surveys and to projects see page 257, Annual Report of the Chief of Engineers for 1904.

#### COMMERCIAL STATISTICS.

[Furnished by the collector of customs.]

#### *Foreign commerce.*

Year.	Aggregate registered tons.	Value.	Year.	Aggregate registered tons.	Value.
1889.....	211,203	\$16,744,951	1898.....	214,180	\$10,956,250
1890.....	224,962	16,041,397	1899.....	174,525	6,385,168
1891.....	274,149	23,110,664	1900.....	150,631	11,170,910
1892.....	169,379	11,829,607	1901.....	141,003	5,276,757
1893.....	193,336	11,940,129	1902.....	219,069	7,095,294
1894.....	203,169	11,560,372	1903.....	142,196	5,237,119
1895.....	140,938	10,586,326	1904.....	146,966	6,100,295
1896.....	158,325	11,785,846	1905.....	106,351	3,337,038
1897.....	226,750	12,106,763	1906.....	132,400	4,165,567

#### *Commerce through Charleston Harbor, ocean entrance.*

Year.	Total imports and exports.	Value.
	<i>Tons.</i>	
1901.....	784,812	\$29,454,515
1902.....	822,845	34,746,997
1903.....	685,903	47,659,427
1904.....	880,596	49,994,894
1905.....	858,016	51,631,040
1906.....	835,360	56,301,096

One new line of transportation was established during the year.

Regarding effect on freight rates since improvement began in 1878, the only change that seems due to the improvement is a lowering of about 12½ cents per ton on business done by coastwise sailing vessels.

The additional work proposed is for extension of benefits.

July 1, 1906, balance unexpended.....	\$23, 419. 96
Received account sales .....	1, 210. 61
Amount appropriated by river and harbor act approved March 2, 1907.....	25, 000. 00
	<hr/> 49, 630. 57
June 30, 1907, amount expended during fiscal year, for works of improvement .....	23, 942. 45
July 1, 1907, balance unexpended.....	25, 688. 12
July 1, 1907, outstanding liabilities.....	14. 47
July 1, 1907, balance available.....	25, 673. 65
(See Appendix N 10.)	

IMPROVEMENT OF RIVERS AND HARBORS IN EASTERN GEORGIA, OF INSIDE WATER ROUTE BETWEEN SAVANNAH, GEORGIA, AND FERNANDINA, FLORIDA, OF CUMBERLAND SOUND, GEORGIA AND FLORIDA, AND OF FERNANDINA HARBOR, FLORIDA.

This district was in the charge of Lieut. Col. Dan C. Kingman, Corps of Engineers.

1. *Savannah Harbor, Georgia.*—This covers the estuary of the Savannah River from about 2 miles above the city of Savannah to the ocean bar, about 22 miles below the city. In 1873 the channel was in places not more than 9 feet deep at mean low water.

The first appropriation for the improvement of this harbor was made in 1826, and had reference to the removal of natural and artificial obstructions, but the first comprehensive plan of improvement is dated February 11, 1853. Another, for the removal of obstructions, is dated about 1871.

A later plan of improvement is dated August 28, 1873, and was supplemented March 19, 1879. It contemplated the establishment of a channel from the city to the sea, practicable at high tide for vessels drawing 22 feet of water. This project was replaced by an enlarged one (January 16, 1882, Annual Report of the Chief of Engineers for 1882, Appendix J 4) contemplating the same channel depth. The amount expended under these projects up to June 30, 1890, was \$1,875,061.59.

The project in force up to June 13, 1902, adopted in 1890, providing for a mean high-water depth of 26 feet from the city to the sea, is printed as part of Appendix O, Annual Report of the Chief of Engineers for 1890. The channel depth contemplated by it was reported as having been obtained at the end of the fiscal year 1896. While the project depth was literally obtained, the channel was very crooked and of much less than the project width.

A supplemental plan of improvement was submitted December 7, 1894, providing for a detached extension of the Oyster Bed training wall, for the purpose of sheltering the anchorage in Tybee Roads, as well as for protecting the ship channel over the outer part of Tybee Knoll against the destructive action of heavy storms. This project, which is printed as part of Appendix M 1 of the Annual Report of the Chief of Engineers for 1895, was authorized by act of Congress of June 3, 1896, its estimated cost being \$992,250. The same act authorized the completion of work for improving the inside route from Savannah, Ga., to Beaufort, S. C., at an additional cost of



\$106,700, and dredging for maintenance in Savannah Harbor, and the sum of \$1,005,000 was appropriated to complete these works.

The amount expended under the project of 1890 up to June 30, 1896, was \$3,460,049.99, of which \$974,504.88 was for dredging and \$2,356,720.10 for contraction work. There had previously been expended \$1,875,061.59, giving a total of \$5,335,111.58. Between June 30, 1896, and June 30, 1902, \$712,918.84 was expended on the modified 26-foot project of which \$84,850.98 was for maintenance.

From the time of the reported completion of the project of 1890, in July, 1896, until June 30, 1902, extensive dredging was done, both for maintenance and as part of the modification of the project.

On June 13, 1902, Congress adopted a project which provided for the establishment of a channel from the Old Waterworks (2 miles above Savannah) to the ocean 28 feet deep at mean high water with bottom widths of 350 to 500 feet, to be accomplished by dredging and the raising of all existing training walls between Savannah and Tybee Roads. It also provided for the construction of mooring dolphins at two points in the harbor—the "Bight" and Venus Point. The estimated cost of the work was originally \$1,567,791. This amount was increased by \$210,000 by the act of Congress approved March 3, 1905. This project will be found printed in House Document No. 123, Fifty-sixth Congress, second session, and also in the Annual Report of the Chief of Engineers for 1901, page 1723.

The river and harbor act of March 3, 1905, called for a resurvey of Savannah Harbor, Georgia, with plans and estimates of cost, with a view to securing a channel to the sea 26 feet deep at mean low water. The survey was made and the plans and estimates prepared, and will be found printed as House Document No. 181, Fifty-ninth Congress, first session. This project was not adopted by Congress in its entirety, but the river and harbor act of March 2, 1907, appropriated \$300,000, and authorized continuing contracts in the sum of \$700,000, yet to be appropriated, for prosecuting the improvement and for maintenance in accordance with the plans of the Board of Engineers for Rivers and Harbors, as set forth in the House document just referred to. The recommendation of the Board was that the improvement should be undertaken in a tentative manner, with the object of first securing across the bar the maximum depth within the limits fixed by Congress that can be maintained by dredging alone, a 21-foot channel first to be dredged and then gradually deepened until the limit fixed by economy of maintenance is reached. The act authorized such raising and extending of dikes, jetties, and other contraction works as may be necessary at a cost not to exceed \$300,000, and the purchase of a pumping dredge of the stationary type at a cost of \$125,000. The increased depth gained upon the bar is to be carried up the river by dredging, if necessary, at such a rate as will insure the same navigable depth as is maintained on the bar.

The amount expended under the 28-foot project up to June 30, 1907, was \$1,643,282.29, of which \$214,043.28 was for maintenance. The sum of \$672.25 has been derived from sales of Government property and deposited to the credit of the appropriation.

The expenditures to June 30, 1907, under the tentative project adopted March 2, 1907, amounted to \$171.67, and were made by Maj. J. C. Sanford, Corps of Engineers, for the construction of the dredge

provided for by the project, details of which will be found in Appendix H 9.

The total amount expended for the improvement of Savannah Harbor up to June 30, 1907, was \$7,691,484.38. The expenditure of this sum has secured and maintained the various objects had in view in the projects heretofore stated and with the net result of securing a navigable channel not less than 22 feet deep at mean low water from the wharves of Savannah to the sea.

Savannah Harbor is navigable from its mouth up to the Old Waterworks, 2 miles above the city—a distance of 22 miles.

During the past fiscal year operations have been carried on under the 28-foot project, adopted by the act of June 13, 1902. At the close of the year this project was about 95 per cent completed. From the Old Waterworks, down the river, and out through Tybee Roads a channel of the project width and depth has been secured, but the full depth does not exist to-day upon the upper portion of the river for a distance of 1,600 feet below the Old Waterworks, in consequence of washing down of the sand from the shallow reaches above. Over this portion of the harbor the controlling depth is 22 feet at mean high water (16 feet at mean low water). Redredging for the purpose of maintenance can be deferred for a time, as this upper portion of the harbor is not now needed for the use of large vessels. Elsewhere at certain localities the full width does not exist, due to silting or to wash from the sides of the cut. Across the outer bar there has been secured a channel 400 feet wide, with a least depth of 28 feet at mean high water (21 feet at mean low water). Through the center of this channel, for a width of 200 feet, there is a controlling depth of 30 feet at mean high water (23 feet at mean low water). This increased depth along the axis of the channel is advantageous to commerce and naturally results from the use of seagoing hydraulic dredges. Work upon this channel was in progress at the close of the fiscal year, to give the full project width of 500 feet, provided for in the 28-foot project, and to carry out the tentative project.

Work done for maintenance during the fiscal year consisted in the removal of 344,243 cubic yards of material from the inner harbor by United States seagoing dredges, and the rehandling of 280,540 cubic yards of this amount by a pump dredge, which cast the material ashore from the basin of deposit at the Venus Point mooring dolphin.

The mean rise and fall of tide on the outer bar is 7 feet; on Tybee Knoll, 6.8 feet, and from that point to the upper limits of the harbor it averages 6.4 feet.

The small amount of work yet remaining to be done for the technical completion of the 28-foot project is completely covered by and included in the tentative project authorized by Congress. It is therefore proposed to expend the balance on hand and the additional appropriation asked for in carrying forward this tentative project, i. e., in widening and deepening the channel on the bar toward the limits of economical maintenance and in extending the increased depth gained up to the city, and in raising, strengthening, and extending, if necessary, the existing training dikes and jetties.

The additional work proposed is for extension of benefits.

In 1872 the tonnage of vessels arriving and clearing at Savannah Harbor was reported to be somewhat more than 1,000,000 and the

total value of imports and exports about \$34,000,000. In 1890 the total tonnage was reported to have increased about 2,000,000 and the value of imports and exports to \$152,000,000. For the calendar year 1906 the total amount of freight received and shipped at the port was 3,801,049 tons, valued at \$194,836,773, an increase over the previous year of 72,508 tons. The commerce consists principally of naval stores, fertilizers, produce, iron, cotton, lumber, and general merchandise.

The effect of the improvement upon freight rates since 1896 has been a reduction of from 30 to 50 per cent, according to the nature of the commodity.

A list of Reports of the Chief of Engineers and executive documents, in which the various projects, examinations, surveys, maps, etc., are printed, may be found on page 272 of the Annual Report of the Chief of Engineers for 1905. A map of the harbor, showing conditions on June 30, 1906, will be found in the Annual Report of the Chief of Engineers for 1906, opposite page 1192.

Reference to report on resurvey of the harbor required by the river and harbor act of March 3, 1905, will be found on page 311 of the Annual Report of the Chief of Engineers for 1906.

July 1, 1906, balance unexpended.....	\$192, 200. 64
Amounts received from proceeds sale of Government property.....	587. 25
Amount appropriated by river and harbor act approved March 2, 1907.....	300, 000. 00
Amount appropriated by sundry civil act approved March 4, 1907..	60, 000. 00
	<hr/> 552, 787. 89
June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	<sup>a</sup> \$91, 455. 88
For maintenance of improvement.....	67, 246. 09
	<hr/> 158, 701. 97

July 1, 1907, balance unexpended.....	<sup>b</sup> 394, 085. 92
July 1, 1907, outstanding liabilities.....	12, 683. 34
	<hr/> 381, 402. 58
July 1, 1907, balance available.....	<hr/> <hr/> 381, 402. 58
Amount (estimated) required for completion of existing tentative project.....	700, 000. 00

Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907.....	350, 000. 00
Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

(See Appendix O 1.)

2. *Savannah River below Augusta, Ga.*—This river is navigable from Savannah to Augusta, Ga., a distance of 202 miles. Previous to improvement there were numerous shoals in the river, with less than 3 feet at summer low water, the other obstructions consisting of overhanging trees, snags, and sunken logs. The aggregate length of river upon which there was less than 5 feet was about 9,800 feet, divided up into 10 shoals, and the controlling depth was about 2½ feet.

<sup>a</sup> Includes \$171.67, expended by Maj. J. C. Sanford, Corps of Engineers, for construction of pumping dredge.

<sup>b</sup> Includes \$1,828.33 drawn by Maj. J. C. Sanford, Corps of Engineers, in connection with construction of dredge.

The original project, submitted December 22, 1880, provided for a 5-foot channel, 80 feet wide, by means of removal of snags, trees, sand bars, etc., and protection of banks, at a cost of \$91,000.

Under this project there was expended, prior to operations under the existing project, \$93,480.09.

The existing project, adopted in 1890, provides for the establishment of a navigable steamboat channel 5 feet deep at ordinary summer low water between the cities of Augusta and Savannah, to be accomplished by removing sand and gravel bars, regulating portions of the river, revetting caving banks, closing incipient cut-offs, and removing snags and logs from the channel and overhanging trees from the banks of the stream.

The total estimated cost of this improvement, in round numbers, was \$332,000, on the supposition that funds were regularly and adequately supplied, besides \$3,000 to \$5,000 annually for maintenance.

The river and harbor act of March 2, 1907, provided for a survey of the river for 30 miles below Augusta.

The amount expended upon the work under the existing project up to June 30, 1907, was \$381,291.56 (of which \$22,838.10 was for maintenance), which, added to the amount previously expended, gives a total expenditure for this work of \$474,771.65.

A total of \$655.77 has been received from sales of unserviceable property and deposited to the credit of the appropriation.

The work done under the present project has resulted in the removal of great numbers of snags and stumps from the river channel and the cutting of numerous overhanging trees on the banks. Sand bars have been removed by means of training dikes and shore protection at 11 localities. A great deal of work, however, remains to be done, principally in the upper 30 miles of the river, where there are sand shoals with only 3 feet of water over them. A great many snags also require removal.

All work done during the fiscal year was for maintenance and consisted of the following: A training wall, 200 feet in length, was constructed on the Georgia side of the river at Tweedys bar, to which an additional length of 400 feet was added later on, and 60 linear feet of an old dike on the South Carolina side of the river was removed, as this portion of the dike obstructed passage through the new channel which had formed at this place. This work was done under two contracts. Also in making minor repairs to the snag boat *Tugaloo*.

The proportion of the approved project accomplished up to June 30, 1907, was about 75 per cent.

At the close of the fiscal year the project depth of 5 feet can be carried from Savannah to Augusta, except at two or three places near Augusta, where the controlling depth at an ordinary stage of summer low water is from 3 to 3.5 feet. The river very rarely goes below 3 feet and rises more than 30 feet in times of floods, frequently standing for long periods at several feet above summer low water. Existing training and shore protection dikes are in a generally fair condition, except in the case of one training dike at Tweedys bar, which is very much in need of repairs.

In the upper 30 miles of the river the banks in many places cave more or less with every high freshet, and the problem of obtaining

and maintaining the project depth is easily solved if the erosion of the banks can be stopped.

The improvements are at present just at that stage where it is necessary to continue the work of revetting the banks and keeping in repair the numerous dikes. Quite a large number of snags and overhanging trees require removal.

It is proposed to apply the available balance toward keeping the channel cleared of snags and similar obstructions, the construction of additional training and shore protection dikes in the 30 miles of river just below Augusta, and in making such repairs to existing dikes as may be required. The additional work proposed is for extension of benefits.

Prior to the improvement the commerce was small, but its quantity unknown. The total commerce of the river during the calendar year 1906 amounted to 54,800 tons, valued at \$5,410,000. It consists principally of cotton and cotton factory products, naval stores, fertilizers, and general merchandise. There was also rafted down the river during 1906 about 16,911,500 feet B. M. of timber, valued at about \$186,148.

The effect of the improvement upon freight rates has been a reduction of from 30 to 50 per cent, according to the nature of the commodity.

A list of Reports of the Chief of Engineers and of executive documents, in which projects of improvement, maps, etc., are printed, may be found on pages 274 and 275 of the Annual Report of the Chief of Engineers for 1905.

July 1, 1906, balance unexpended.....	\$1, 316. 16
Amount allotted from emergency appropriation, act of March 3, 1905.....	2, 000. 00
Amount appropriated by river and harbor act approved March 2, 1907.....	30, 000. 00
	<hr/>
	33, 316. 16
June 30, 1907, amount expended during fiscal year, for maintenance of improvement .....	3, 932. 04
	<hr/>
July 1, 1907, balance unexpended.....	29, 384. 12
July 1, 1907, outstanding liabilities.....	1, 906. 06
	<hr/>
July 1, 1907, balance available.....	27, 478. 06

(See Appendix O 2.)

3. *Savannah River above Augusta, Ga.*—This portion of the Savannah River is navigable only by pole boats from the locks, 7 miles above the city of Augusta, to Petersburg, a distance of 48 miles. In its original condition the river at low water was navigable only with great difficulty, on account of shallow water, obstructing logs, etc.

The original project of improvement, submitted February 8, 1879, provided for a 3-foot channel, 30 feet wide, from Augusta, Ga., to Trotters shoals, and the removal of snags, trees, etc., to the Tugaloo River, at a cost of \$45,000.

Under this project there was expended, prior to operations under the existing project, \$39,000.

The existing plan of improvement, adopted by Congress July 13, 1892, provides for the establishment, between Petersburg and the locks, of a downstream channel 12 to 25 feet in width and navigable during ordinary summer low water for pole boats drawing 2 feet, and

of an upstream channel navigable for pole boats drawing 1.3 feet of water. This is to be obtained by removing logs and overhanging trees; excavating rock, sand, or gravel, and with excavated materials raising crests of ledges; constructing training walls to increase flow of water through sluices. The total estimated cost is \$33,000.

The total amount expended under the present project up to June 30, 1907, was \$22,000, which, added to that previously expended, gives a total for this work of \$61,000. No funds have been expended for maintenance.

The work accomplished under this project has given a downstream channel about 2 feet deep and an upstream channel of the project depth. In many places, however, these channels are difficult to navigate and are capable of greater improvement.

The proportion of the approved project accomplished up to June 30, 1907, was about 55 per cent.

The additional work proposed is for extension of benefits.

In 1876-77 about 2,000 tons of freight went upstream and about 12,000 bales of cotton came down. In 1906 the total freight carried on this portion of Savannah River amounted to 1,416 tons, valued at \$185,000. The commerce consists of cotton, grain, fertilizers, and general merchandise, and is carried on exclusively by pole boats.

The effect of the improvement has been to render navigation safer and easier, but it is impossible to determine whether it has caused any reduction in freight rates.

A list of Reports of the Chief of Engineers and of executive documents containing the projects of improvement, maps, etc., may be found on page 276 of the Annual Report of the Chief of Engineers for 1905.

Amount appropriated by river and harbor act approved March 2, 1907.	\$3,000.00
July 1, 1907, balance unexpended.....	3,000.00
Amount (estimated) required for completion of existing project.....	8,000.00

(See Appendix O 3.)

*4. Harbor at Darien, and Doboy bar, Georgia.—(a) Darien Harbor.*—This harbor is navigable from its mouth to the town of Darien, a distance of 13 miles.

In its original condition it was obstructed at seven points by shoals, with mean low-water depths of from  $6\frac{1}{2}$  to  $10\frac{1}{2}$  feet. Between the shoals there was nowhere less than 12 feet at mean low water.

There was expended on this harbor in 1879 for dredging \$8,000, without any project having been recommended or adopted.

The project for the improvement of this harbor, adopted in 1885, contemplates the establishment of a navigable channel 12 feet deep at mean low water between Darien and Doboy at an estimated cost of \$170,000. Work was not begun under this project until 1891. The total amount expended under it up to June 30, 1907, was \$157,366.65 (of which \$20,572.75 was for maintenance), which, added to the amount previously expended, gives a total for this work of \$165,366.65. The work done under the present project has resulted in a navigable channel 12 feet deep at mean low water from Darien to Doboy. The project was reported as completed July 11, 1905.

The sum of 69 cents, refundment, was received and deposited to the credit of the appropriation.



On June 30, 1907, the controlling depth in the harbor was 10.7 feet at mean low water, shoaling having occurred at two or three places since the project depth of 12 feet was obtained in July, 1905. The mean rise and fall of tide is from 6.5 feet at Darien to 7 feet at the entrance.

The additional work proposed is for maintenance only.

The total tonnage for 1878 was estimated at about 200,000 and the value of exports at between \$600,000 and \$700,000. The commerce consists almost entirely of timber, and in 1906 it amounted to 130,991 tons, valued at \$1,231,666, an increase over the year previous of 48,783 tons and \$508,459 in valuation.

The improvement of this harbor has rendered it possible to ship lumber from Darien, which before was impracticable, and has caused a reduction in freight rates of about 15 per cent.

A list of the Reports of the Chief of Engineers in which the project of improvement, history of the work, etc., are printed may be found on page 277 of the Annual Report of the Chief of Engineers for 1905.

By act of Congress approved June 13, 1902, this work was consolidated with Doboy bar, Georgia.

July 1, 1906, balance unexpended.....	\$4,338.39
Amount received from refundment.....	.69

June 30, 1907, amount expended during fiscal year, for works of improvement.....	4,339.08
	4,339.08

(b) *Doboy bar*.—In 1888, \$5,795.40 was spent in harrowing and water-jet work on this bar without result. In its original condition there was about 12 feet at mean low water in the old channel, which was very crooked, so that the entrance was not much used.

The project for its improvement, adopted by act of Congress of March 3, 1899, provides for creating a channel by dredging 24 feet deep at mean high water and 300 feet wide, estimated to cost \$70,000. The proposed channel is some distance north of the old channel.

The amount expended under the project up to June 30, 1907, was \$49,134.14, which, added to the amount previously expended, gives a total expenditure for this work of \$54,929.54. No funds have been expended for maintenance.

The sum of 10 cents, refundment, was received and deposited to the credit of the appropriation.

By act of Congress approved June 13, 1902, this work was consolidated with Darien Harbor.

The work which has been done under the existing project secured a channel across the bar 150 feet in width, with a controlling depth of 12 feet at mean low water.

The mean rise and fall of tide on the bar is 7 feet.

Practically no advancement has been made toward the completion of the approved project, and it is quite doubtful if the desired improvement at this bar can be effected by dredging alone, except at great cost. None of the channels across the bar appear to have any stability. Extensive sand shoals lie to the north and south of the entrance to the sound, and the material comprising them is easily transported by the littoral currents, which are very strong in this vicinity under the influence of northeast or southeast winds. The

approved project calls for a channel 24 feet deep at mean high water (17 feet at mean low water), while a channel only 12 feet at mean low water has been dredged. This latter depth, however, corresponds with the project depth for Darien Harbor, and it would appear that the maintenance of a channel of this depth across the bar would be sufficient to meet the demands of the present commerce.

Since the suspension of dredging in May, 1906, it is known that shoaling has occurred to such extent as to materially reduce the available depth in the channel, and from information furnished by pilots it is believed that the dredged channel had, on June 30, a depth less than that in the old ship channel, which had a controlling depth of 11 feet at mean low water. The new channel has never been marked for navigation and practically all the shipping in and out of Darien uses the old ship channel. Two attempts were made to determine the exact conditions in the dredged channel during June, but the taking of soundings was prevented both times by stormy weather.

No additional work is proposed and no appropriation is recommended.

The commerce interested in this bar consists of lumber received from the Altamaha River and its tributaries, the bulk of which is now shipped from Sapelo Sound and St. Simons Sound, north and south, respectively, of Doboy bar. During the calendar year 1906 5,870,921 feet of lumber, valued at \$155,000, and two cargoes of roofing tiles for Panama, valued at \$37,500, crossed the bar.

A list of the Reports of the Chief of Engineers and of executive documents in which projects, maps, and history of the work are printed may be found on page 278 of the Annual Report of the Chief of Engineers for 1905.

July 1, 1906, balance unexpended.....	\$1, 000. 00
Amount received from refundment.....	. 10
	<hr/>
	1, 000. 10
June 30, 1907, amount expended during fiscal year, for works of improvement .....	1, 000. 10

CONSOLIDATED.

July 1, 1906, balance unexpended.....	\$5, 338. 39
Amount received from refundment.....	. 79
	<hr/>
	5, 339. 18
June 30, 1907, amount expended during fiscal year, for works of improvement .....	5, 339. 18

(See Appendix O 4.)

5. *Altamaha, Oconee, and Ocmulgee rivers, Georgia.*—These three improvements were consolidated by the river and harbor act of March 2, 1907.

(a) *Altamaha River, Georgia.*—This river is formed by the junction of the Oconee and Ocmulgee rivers. At a point some 25 miles from its mouth the river branches, and the river traffic reaches the ocean by two routes—one by the north branch by way of Darien, and the other by the south branch to where it intercepts the inside waterway, which passage is taken to Brunswick.



Before improvement the Altamaha River was obstructed by rock ledges, sand bars, snags, sunken logs, and overhanging trees. The low-water depths at some points did not exceed 1 foot.

The original project of improvement, submitted in 1875, contemplated a channel 4 feet deep and 80 feet wide from Macon to Darien by the removal of sand bars, rock shoals, snags, overhanging trees, etc., at a cost of \$162,000.

Under it and its modifications there was expended up to June 30, 1890, \$69,776. 59.

The existing project of improvement, adopted by Congress in 1890, provides for the establishment of a channel 3 feet deep at summer low water throughout the river above Darien. This is to be accomplished by removing rock shoals and sand bars, building deflecting dikes, and closing incipient cut-offs, removing snags and sunken logs from the channel and overhanging trees from the banks of the stream, and retvetting caving banks. The total estimated cost of the improvement is \$129,000, provided funds are regularly and adequately supplied, besides from \$3,000 to \$5,000 for annual maintenance.

The amount expended on the work under the present project up to June 30, 1907, was \$82,508.76 (of which \$9,985.13 was for maintenance), which, added to the amount previously expended, gives a total expenditure for this work of \$152,285.35.

A total of \$111.50 has been received from proceeds of sales of un-serviceable property and deposited to the credit of the appropriation.

This expenditure has resulted in the removal of two rock shoals, three sand bars, numerous snags, sunken logs, stumps, and overhanging trees, and the straightening of the river at several points by cut-offs.

The river is navigable from the forks to Darien, a distance of 131 miles, and to where it reaches the inside waterway. The lower section of the river is affected by the tides. The worst shoal is at Coupers bar, which at low water has only about  $2\frac{1}{2}$  feet of water, but by waiting on tides 5 feet can be had at this place. The controlling depth above the tidal range is about  $2\frac{1}{2}$  feet at summer low water. The river is subject to freshets, and in the upper sections the freshet height at times goes 20 feet above the low summer stage. The lower section is bordered by low swamp lands, and the freshets rise from 5 to 10 feet over the banks.

The work done for maintenance during the fiscal year consisted in the removal of 168 snags, 3 stumps, and 1 sunken flat boat from the river channel, and the cutting of 103 overhanging trees, and the girdling of 59 trees on the banks.

The proportion of the approved project accomplished up to June 30, 1907, was about 67 per cent.

It is proposed to apply the available balance in removing snags, stumps, and overhanging trees, in removing sand bars and rock shoals, and in repairing old works of improvement.

The additional work proposed is for extension of benefits.

The commerce of the river before the improvement was begun was reported to have amounted to about 100,000 tons annually, valued at about \$1,000,000. During the calendar year 1906 it amounted to 14,000 tons, valued at \$449,000. There was also rafted down the river during the same period 83,800,000 feet B. M. of timber, valued at \$1,185,000.

As nearly as can be determined, the effect of the improvement has been to cause a reduction of from 25 to 40 per cent in freight rates.

A list of Annual Reports of the Chief of Engineers and of executive documents containing projects of improvement, history of the work, maps, etc., may be found on page 279 of the Annual Report of the Chief of Engineers for 1905.

July 1, 1906, balance unexpended.....	\$5, 437. 31
Amount received from proceeds sale of Government property.....	111. 50
Amount allotted from appropriation by river and harbor act approved	
March 2, 1907.....	17, 000. 00
	<hr/> 22, 548. 81

June 30, 1907, amount expended during fiscal year:

For works of improvement.....	\$1, 737. 53
For maintenance of improvement.....	985. 13
	<hr/> 2, 722. 66

July 1, 1907, balance unexpended.....	19, 826. 15
July 1, 1907, outstanding liabilities.....	2, 762. 80

July 1, 1907, balance available.....	17, 063. 35
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Amount (estimated) required for completion of existing project.....	99, 000. 00
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(b) *Oconee River, Georgia.*—The head of navigation on this river is Milledgeville, Ga., 147 miles from the mouth, though at present this point can only be reached during high stages of the river.

The river is navigable also for a distance of 17 miles between the Georgia Railroad bridge (54 miles above Milledgeville) and the northern boundary of Greene County. Between Milledgeville and the Georgia Railroad bridge, above, the river is obstructed by obstacles, both natural and artificial, and is incapable of improvement except by an expensive system of locks and dams. At ordinary stages the river is at present only navigable to a point about 25 miles above Dublin, Ga., a distance of 104 miles from its mouth. In its original condition this river was used principally for navigation at high stages. At low water there were numerous shoals and snags, there probably being less than 2 feet on many sand bars and rock ledges.

The original project was submitted January 29, 1875, and provided for the removal of snags, overhanging trees, etc., cutting off points, and making cut-offs, at a cost of \$10,150.

Under this project and its modifications there was expended, previous to the commencement of operations under the existing project, the sum of \$44,822.18.

The existing project of improvement was adopted by Congress September 19, 1890. It provides for the establishment of a navigable channel 3 feet deep at ordinary summer low water from Milledgeville to the mouth. This is to be accomplished by removing rock shoals and sand bars, retvetting caving banks, and closing incipient cut-offs, removing snags and logs from the channel and overhanging trees from the banks of the stream. The cost of the improvement is estimated at \$171,000, besides from \$3,000 to \$5,000 for annual maintenance. The river and harbor act of March 3, 1905, authorized the expenditure of \$3,000 of the amount appropriated to be applied to cleaning out the river from the Georgia Railroad bridge to the northern boundary of Greene County, Ga., thus bringing this short section under improvement.

The amount expended under the present project up to June 30, 1907, was \$124,524.28 (of which \$5,291.36 was for maintenance), which, added to the amount previously expended, gives a total expenditure for this work of \$169,346.46.

A total of \$648.77 has been received from sales of unserviceable property and 50 cents from refundment, which was deposited to the credit of the appropriation.

As a result of this expenditure numerous snags and logs, bowlders, and overhanging trees have been removed, several cut-offs opened and others closed, four training dikes built, and three rock shoals removed below Milledgeville. Between the Georgia Railroad bridge, above Milledgeville, and the northern boundary of Greene County the most troublesome obstructions have been removed from the channel and numerous overhanging trees and logs cut on the banks.

Work done for maintenance during the fiscal year consisted in the removal, between the forks and a point 25 miles above Dublin, of 654 snags and 66 stumps and 4 cubic yards of rock from the channel and the cutting of 531 overhanging trees and the girdling of 44 trees on the banks; also in repairs to floating plant.

On June 30 the controlling depth at ordinary summer low water between the forks and the Central of Georgia Railway bridge, 25 miles above Dublin, was 2.5 feet, and between the latter point and Milledgeville, 1.5 feet. From the Georgia Railroad bridge, above Milledgeville, to the northern boundary of Greene County the controlling depth was 2.5 feet. This river occasionally falls below these depths and frequently rises to 20 feet above them.

The proportion of the approved project accomplished up to June 30, 1907, was about 61 per cent.

It is proposed to apply the available balance toward the removal of snags and stumps from the channel and the cutting of overhanging trees from the forks to Milledgeville; the removal of rock and sand shoals between the forks and the Central of Georgia Railway bridge, 25 miles above Dublin; in making such repairs to existing dikes as may become necessary, and in closing incipient cut-offs and opening others wherever found advisable. No additional work above Milledgeville is proposed.

The additional work proposed is for extension of benefits between the forks and the Central of Georgia Railway bridge above Dublin; between the Central of Georgia Railway bridge (above Dublin) and Milledgeville the additional work proposed is necessary to make the improvement available.

No reliable statistics of the commerce of the river before the improvement was begun are available. During the calendar year 1906 the amount of freight carried on the river between the forks and Milledgeville amounted to 49,000 tons, valued at \$500,000. There were also rafted on this portion of the river during 1905, 42,455,437 feet B. M. of timber, valued at about \$546,800. During the same period there was carried over that portion of the river between the Georgia Railway bridge (54 miles above Milledgeville) and the northern boundary of Greene County 1,246 tons of freight, valued at \$40,000.

As nearly as can be determined, the effect of the improvement has been to cause a reduction of from 25 to 40 per cent in freight rates.

A list of the Annual Reports of the Chief of Engineers and of executive documents, containing the various projects, maps, history of the work, etc., may be found printed on pages 280 and 281 of the Annual Report of the Chief of Engineers for 1905.

July 1, 1906, balance unexpended.....	\$4, 032. 35
Amount received from refundment.....	. 50
Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	29, 000. 00
	<hr/> 33, 032. 85

June 30, 1907, amount expended during fiscal year:

For works of improvement.....	\$2, 438. 68
For maintenance of improvement.....	1, 541. 36
	<hr/> 3, 980. 04

July 1, 1907, balance unexpended.....	29, 052. 81
July 1, 1907, outstanding liabilities.....	1, 280. 00
	<hr/> 27, 772. 81

Amount (estimated) required for completion of existing project.... 94, 842. 00

(c) *Ocmulgee River, Georgia*.—In its original condition this river was used for navigation chiefly at high stages. At low water there were numerous shoals and snags, there probably being less than 2 feet on many sand bars and rock ledges.

The head of navigation on this river is Macon, a distance of 202 miles from the forks.

The original project was submitted in 1875 and provided for a channel 80 feet wide and 4 feet deep at low water, to be accomplished by the removal of sand bars, rock shoals, snags, overhanging trees, etc., from Macon to Darien, at a cost of \$162,000.

The amount expended under this project and its modifications prior to operations under the existing project was \$79,390.73.

The existing project of improvement, adopted by Congress September 19, 1890, provides for the establishment of a navigable channel 3 feet deep at ordinary summer low water from Macon to the river's mouth. This is to be obtained by removing rock shoals and sand bars, closing incipient cut-offs, revetting caving banks, and removing snags and logs from the channel and overhanging trees from the banks of the stream.

The cost of the improvement as given in the project of 1890 is estimated at \$210,000, provided funds are regularly and adequately provided, besides from \$3,000 to \$5,000 for annual maintenance.

The amount expended under the present project up to June 30, 1907, was \$246,297.74 (of which \$17,920.81 was for maintenance), which, added to the amount previously expended, gives a total of \$325,688.47.

A total of \$739.76, received from sales of unserviceable property, and \$20.45, refundments, have been received and deposited to the credit of the appropriation.

The work under the present project has resulted in a navigable channel from the forks to Macon. A great deal of work, however, remains to be done between Hawkinsville and Macon.

Work for maintenance during the fiscal year consisted in the removal of 548 snags and 39 stumps from the channel and 12 logs

from the banks, and the cutting of 1,506 overhanging trees, and the girdling of 113 trees on the banks of the stream, and in repairs to a training wall and spur dam just below Macon, involving the use of about 1,400 cubic yards of brush.

On June 30 the controlling depth between the forks and Macon was practically 3 feet at ordinary summer low water. The river occasionally falls a foot below the ordinary summer stage and frequently rises 20 feet above.

The proportion of the approved project accomplished up to June 30, 1907, was about 90 per cent.

It is proposed to apply the available balance in the removal of logs, snags, stumps, and overhanging trees, in the removal of rock and sand shoals, maintaining existing training dikes and shore protections, and in closing incipient cut-offs and opening others wherever deemed advisable.

The additional work proposed is for extension of benefits.

No reliable statistics of the commerce of the river before improvement was begun are available. In 1906 the freight carried on the river amounted to 18,000 tons, valued at about \$550,000. Besides this, 35,500,000 feet B. M. of timber was rafted down the river, valued at about \$567,000. For several years past there has been no navigation at all between Hawkinsville and Macon, except that one small steamer made occasional trips to Macon. A company has been formed at Macon for the purpose of operating a line of steamers between that point and Brunswick, and has two steamers now under construction for that purpose.

As nearly as can be determined, the effect of the improvement has been to cause a reduction of from 25 to 40 per cent in freight rates. A list of the Annual Reports of the Chief of Engineers and of executive documents containing the various projects, history of the work, maps, etc., may be found printed on page 282 of the Annual Report of the Chief of Engineers for 1905.

Reference to report on examination of the river ordered by the river and harbor act of March 3, 1905, will be found on page 311 of the Annual Report of the Chief of Engineers for 1906.

July 1, 1906, balance unexpended.....	\$9,051.35
Amount received from refundment.....	.45
Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	29,000.00
	<hr/> 38,051.80
June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$3,480.06
For maintenance of improvement.....	5,000.00
	<hr/> 8,480.06
July 1, 1907, balance unexpended.....	29,571.74
July 1, 1907, outstanding liabilities.....	1,100.00
	<hr/>
July 1, 1907, balance available.....	28,471.74

## CONSOLIDATED.

July 1, 1906, balance unexpended-----	\$18, 521. 01
Amount received from refundments-----	. 95
Amount received from proceeds sale of Government property-----	111. 50
Amount appropriated by river and harbor act approved March 2, 1907-----	75, 000. 00
	<hr/>
	93, 633. 46
June 30, 1907, amount expended during fiscal year :	
For works of improvement-----	\$7, 656. 27
For maintenance of improvement-----	7, 526. 49
	<hr/>
	15, 182. 76
July 1, 1907, balance unexpended-----	78, 450. 70
July 1, 1907, outstanding liabilities-----	5, 142. 80
	<hr/>
July 1, 1907, balance available-----	73, 307. 90
	<hr/>
Amount (estimated) required for completion of existing projects---	193, 842. 00
(See Appendix O 5.)	

6. *Club and Plantation creeks, Georgia.*—A project for dredging a canal 7 feet deep at mean low water, with a bottom width of 50 feet, to connect these two creeks and thus provide an inside route between the Altamaha River and its tributaries and Brunswick Harbor for use of light-draft river boats and timber rafts, will be found printed as House Document No. 159, Fifty-eighth Congress, second session. Besides the dredging of the canal, the project provides for the straightening of Plantation Creek and for dredging in both Club and Plantation creeks, where necessary, to give a channel 7 feet deep at mean low water. The estimated cost of the work is \$40,700. This project was adopted by act of Congress approved March 2, 1907, which appropriated \$20,000 toward its completion.

No work has yet been done. A portion of the route crosses marsh land owned by private individuals, and as yet their consent has not been obtained for the construction of the canal. No provision was made in the act for the purchase of a right of way, but there is reason to think that it will be obtained shortly without cost to the United States.

It is proposed to apply the available balance toward the construction of the work as soon as a free right of way is obtained, pending which no further appropriation will be asked for.

Reports of examination and survey are printed on page 1669 of the Annual Report of the Chief of Engineers for 1904.

Amount appropriated by river and harbor act approved March 2, 1907-----	\$20, 000. 00
July 1, 1907, balance unexpended-----	20, 000. 00
	<hr/>

Amount (estimated) required for completion of existing project----	20, 700. 00
(See Appendix O 6.)	

7. *Brunswick Harbor, Georgia.*—Previous to June 13, 1902, the appropriations for the improvement under the Engineer Department were for the inner harbor only, consisting principally of the removal of a shoal in East River, opposite the lower part of the city. The act of Congress approved June 13, 1902, provided also for the improvement of the bar, which work had theretofore been carried on by direct contract between Congress and a private individual.

The harbor is navigable from the city of Brunswick to deep water beyond the bar, a distance of 13 miles, and also for 1 mile up Academy Creek, and up Turtle River to the Southern Railway wharves.

The original project of improvement, dated April 29, 1876, provided for the construction of a jetty at the city front and dredging, at a total cost of \$69,000.

Under this project and its modifications there was expended, prior to operations under the existing project, the sum of \$190,000.

The project in force up to June 13, 1902, was adopted by Congress in 1894. It provided for the maintenance of a navigable channel 15 feet deep at mean low water by keeping the existing works in repair and by dredging. The act of June 3, 1896, provided for the improvement of Academy Creek. The cost of maintaining a channel depth of 15 feet at mean low water was estimated at \$15,000 per annum.

There had been expended under this project up to June 30, 1902, \$34,817.25, all of which had been for maintenance.

Including \$10,000 spent in 1836 for dredging, the total amount expended up to June 30, 1902, on the inner harbor was \$234,817.25.

The act of Congress approved June 13, 1902, adopted a project providing for a navigable channel 21 feet deep at mean low water in Brunswick inner harbor, at a cost of \$120,000, and for a channel across the outer bar 19.3 feet deep at mean low water (26 feet at mean high water), at a cost of \$40,000. It also provided for dredging in Academy Creek at not to exceed \$5,000. This project was completed in July, 1905, and expenditures since have been for maintenance.

The river and harbor act of March 3, 1905, authorized the expenditure from the amount therein appropriated of \$5,000, or so much thereof as might be necessary, for maintaining in Academy Creek, immediately in front of and adjacent to the wharves thereof, to the Old Altamaha Canal a depth equal to the controlling depth on the shoals at the lower end of the city in East River, provided that no money should be expended inside harbor lines theretofore or thereafter established in said creek. With these funds a channel was dredged with a depth of 18.5 feet at mean low water and a width ranging from 50 to 90 feet.

The amount expended to June 30, 1907, under the project approved June 13, 1902, was \$193,062.15, of which \$19,596.82 was for maintenance. This, added to the amount previously expended, gives a total expenditure for the work of \$427,879.40.

A refundment of 15 cents was received and deposited to the credit of the appropriation.

The result of this expenditure has been the accomplishment of a navigable channel throughout the inner harbor 21 feet deep at mean low water and of a channel across the outer bar 19.3 feet deep at mean low water (both 26 feet at mean high water); also of a narrow channel in Academy Creek above mentioned.

A new project was adopted by the act of Congress approved March 2, 1907. This project will be found printed as House Document No. 407, Fifty-ninth Congress, first session. It provides for creating and maintaining throughout the inner harbor (embracing Turtle River from the Southern Railway docks to its junction with Bruns-

wick River, Academy Creek from Aiken's wharf to its junction with East River) and the outer harbor (embracing the outer bar, the navigable channel throughout the entrance to St. Simons Sound and up Brunswick River to Brunswick Point), channels having a depth of 30 feet at mean high water, with widths varying from 150 feet in Academy Creek to 400 feet across the outer bar, to be accomplished mainly by dredging; but the extension of the existing training wall in East River and the construction of two spur dikes is also authorized. The estimated cost of the work is \$496,650, with a yearly cost of maintenance not exceeding \$33,250.

Congress in adopting this project appropriated the sum of \$146,650 for the work and authorized contracts covering labor and materials necessary for its completion at a cost not to exceed \$350,000 additional, which latter amount remains to be appropriated.

No expenditures have yet been made under this new project.

All work done during the past fiscal year was for maintenance. Surveys were made of the channels in East River, Academy Creek, and Turtle River (inner harbor), and of the channel across the outer bar. The suboffice at Brunswick was maintained and repairs made to survey launches.

On June 30, 1907, the controlling depth in the inner harbor was 19 feet at mean low water on a shoal in Brunswick River opposite Brunswick Point. In East River the controlling depth was 20 feet at mean low water, in Academy Creek 16 feet at mean low water, and in the channel across the outer bar 19.4 feet at mean low water. The mean rise and fall of tide on the bar is 6.6 feet, at Brunswick Point 7 feet, and at the city of Brunswick 7.4 feet.

It is proposed to apply the available balance and additional appropriation recommended, which was authorized by act of March 2, 1907, in carrying out the project adopted by said act.

The additional work proposed is for extension of benefits.

Before improvement in 1880 the annual commerce of Brunswick Harbor amounted to about 100,000 tons, valued at \$1,700,000. The total commerce of the port for the calendar year 1906 amounted to 1,423,985 tons of freight, valued at \$35,892,335. A new line of steamships, known as the Bee Line, was inaugurated in November, 1906, and at the close of the fiscal year there were 5 steamships in this service, plying between Brunswick and New York and Brunswick and Habana, Cuba, and 3 new steamships had been contracted for. This line is operated in connection with the Atlanta, Birmingham and Atlantic Railroad Company, which company is now constructing extensive terminals at Brunswick. The commerce consists principally of cotton, lumber, cross-ties, and naval stores and general merchandise.

The effect of the improvement has been to cause a reduction of ocean-going freight rates on lumber of 25 per cent and on naval stores of 30 per cent.

A list of the Annual Reports of the Chief of Engineers and of executive documents containing the various projects, maps, history of the work, etc., may be found printed on page 284 of the Annual Report of the Chief of Engineers for 1905.

Reference to report on survey of Brunswick Harbor, inner and outer, provided for by the river and harbor act of March 3, 1905,



will be found on page 312 of Annual Report of the Chief of Engineers for 1906.

July 1, 1906, balance unexpended.....	\$14,371.00
Amount received from refundment.....	.15
Amount appropriated by river and harbor act approved March 2, 1907.....	146,650.00
	<hr/> 161,021.15
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	2,250.40
	<hr/> 158,770.75
July 1, 1907, balance unexpended.....	158,770.75
July 1, 1907, outstanding liabilities.....	1,504.85
	<hr/> 157,265.90
July 1, 1907, balance available.....	157,265.90
	<hr/> <hr/> 350,000.00
Amount (estimated) required for completion of existing project....	350,000.00

{	Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907.....	350,000.00
	Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

(See Appendix O 7.)

8. *Inside water route between Savannah, Ga., and Fernandina, Fla.*—This route consists of a series of bays and tidal sloughs, making a connecting waterway not exposed to rough water except at a few points in stormy weather. The waters forming the route are shown on Coast Survey charts Nos. 156 and 157. It is navigable from Savannah, Ga., to Fernandina, Fla., Brunswick, Ga., and Darien, Ga. The distance from Savannah to Fernandina is 160 miles. Touching at Darien en route increases this by about 20 miles and at Brunswick by about 12 miles.

The project of improvement was adopted in 1892 and provides for the establishment of a channel 7 feet deep at mean low water. This is to be accomplished by the improvement of Romerly Marsh, Mud River, Little Mud River, and Jekyl Creek. The estimated cost of the improvement is \$105,000, provided the entire sum be made available at one time.

The total amount expended under this project up to June 30, 1907, was \$104,521.07 (of which \$45,961.21 was for maintenance), which, added to the amount expended for Jekyl Creek and Romerly Marsh, \$71,108.77, makes a total of \$175,629.84.

The river and harbor act of March 2, 1907, appropriated the sum of \$30,000 for continuing the improvement and for maintenance, and authorized a resurvey to be made to determine the best route of said waterway for further improvement. This survey has been ordered.

Work for maintenance during the fiscal year consisted in the redredging of 88,729.8 cubic yards of material from the Dividings and in Mud River under contract, and in the making of a survey of the dredged channel in Mud River and examinations of the channels in Mud River, Little Mud River, Jekyl Creek, and the Dividings, and for office expenses and contingencies.

The proportion of the approved project accomplished up to June 30, 1907, was about 80 per cent.

On June 30, 1907, the controlling depth between Savannah and the mouth of Vernon River was 3 feet, at mean low water, in Parsons

Cut, and between the mouth of Vernon River and Fernandina it was 6 feet, at mean low water, in Mud River. By way of the new route through Skidaway Narrows (now under improvement) the controlling depth between Savannah and the mouth of Vernon River was 2.5 feet, at mean low water. By waiting on the tides, however, at Parsons Cut or at Skidaway Narrows, a navigation in excess of 7 feet could be carried from Savannah to Fernandina.

The mean rise and fall of the tide varies at different localities from 6.5 to 8 feet.

It is proposed to apply the available balance in obtaining and maintaining a 7-foot navigation, at mean low water, throughout the entire route.

The additional work proposed is for extension of benefits.

The value of the commerce passing over this route was estimated in 1890 at between \$200,000 and \$300,000 per annum. During the calendar year 1906 the commerce amounted to 151,835 tons of freight, valued at about \$3,870,160. There were also rafted on this route during 1906 about 97,010,000 feet B. M. of timber valued at about \$1,268,000. Little, if any, of this commerce passed over the whole extent of the route.

It is impracticable to determine the effect of this improvement upon freight rates, as at present the different portions of the route are used locally and comparatively few vessels engaged in commerce pass over the entire length of it.

A list of the Annual Reports of the Chief of Engineers and of executive documents containing the various projects, maps, history of the work, etc., may be found printed in the Annual Report of the Chief of Engineers for 1905, page 285.

July 1, 1906, balance unexpended.....	\$30, 798. 69
Amount appropriated by river and harbor act approved March 2, 1907.....	30, 000. 00
	<hr/>
	60, 798. 69
June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$4, 215. 77
For maintenance of improvement.....	26, 103. 99
	<hr/>
	30, 319. 76
July 1, 1907, balance unexpended.....	30, 478. 93
July 1, 1907, outstanding liabilities.....	144. 00
	<hr/>
July 1, 1907, balance available.....	30, 334. 93
(See Appendix O 8.)	

9. *Skidaway Narrows, Georgia.*—The Narrows is a narrow, tortuous water course, and when improved will constitute an alternative or additional route for a portion of the inside waterway between Savannah, Ga., and Fernandina, Fla. In its present condition it is navigable only at high water for small sailboats and pleasure launches.

The approved project of improvement was adopted by the river and harbor act of March 3, 1905, and will be found printed in the Annual Report of the Chief of Engineers for 1904, pages 1680-1684. This project contemplates the establishment of a navigable channel 6 feet deep at mean low water and 75 feet wide at bottom, connecting Burnside River with Isle of Hope (or Skidaway) River, the route of such channel to be through the marsh and hammock land to the west of the Narrows. Subsequent developments made it necessary to aban-

don this route—principally on account of the difficulty in obtaining the desired right of way through private property. A new route, following practically the course of the Narrows, has been adopted. The estimated cost of the improvement by the new route is \$55,000.

The amount expended up to June 30, 1907, was \$20,567.15.

With the \$20,000 appropriated by the river and harbor act of March 3, 1905, a channel with a bottom width of 60 feet and a depth of 5 feet at mean low water was provided over a portion of the adopted route, making it available for commerce at high water.

With the \$35,000 appropriated by the river and harbor act of March 2, 1907, this channel is to be deepened to 6 feet at mean low water and widened to 75 feet, and a channel of equal proportions dredged along the remainder of the route. Specifications covering this work have been prepared and submitted for approval, and operations will probably be begun early in the coming fiscal year.

A survey of the route was made during April and May, 1907.

At the close of the fiscal year the channel previously dredged had an average depth of  $2\frac{1}{2}$  feet at mean low water, due to the flattening of the side slopes, the wash from the creeks and banks, and possibly in part to silting.

While the work already done renders navigation through the Narrows much easier at high water, the route will not be available at low water until the additional dredging mentioned above is completed.

The mean rise and fall of tide at this locality is 8 feet.

The proportion of the approved project accomplished up to June 30, 1907, was about 40 per cent.

The additional work proposed is necessary to make the improvement available.

As the improvement of Skidaway Narrows will shorten the distance between Savannah and points south on the inside route, it is expected that when it is completed all commerce now going by way of Parsons Cut will make use of the new route through the Narrows.

This improvement has not yet been carried far enough to produce any material reduction in freight rates.

July 1, 1906, balance unexpended.....	\$5, 050. 69
Amount appropriated by river and harbor act approved March 2, 1907.....	35, 000. 00
	<hr/>
	40, 050. 69
June 30, 1907, amount expended during the fiscal year, for works of improvement.....	3, 617. 84
	<hr/>
July 1, 1907, balance unexpended.....	34, 432. 85
(See Appendix O 9.)	

10. *Cumberland Sound, Georgia and Florida.*—In its original condition the available depth at the entrance varied from 11 to 12.5 feet at mean low water. The point of crossing the bar was subject to very great changes in location, moving in a series of years as much as  $1\frac{1}{2}$  miles. The distance from the outer bar to the city of Fernandina, Fla., is about  $6\frac{1}{2}$  miles.

The project of improvement submitted in 1879 and revised by a Board of Engineers in 1891 provides for the construction of two low jetties from the shores on opposite sides of the entrance and extending seaward across the bar upon lines so directed that the ends will be parallel to each other and about 3,900 feet apart. These jetties were

intended to establish a low-water channel across the bar not less than 19 feet in depth. The cost of the improvement was originally estimated at \$2,071,023, and as modified at \$1,606,500, for the completion of low jetties, and at \$2,079,500 if high jetties were found necessary. There was expended under this project \$932,500.

The present project, which was adopted by act of Congress of June 3, 1896, provides for the establishment of a channel across the bar 19 feet deep at mean low water by the construction of two jetties of stone, resting on a foundation of brush mattresses, on the same line as those in the previous project, the scour between the jetties to be aided by dredging, if necessary, the total cost of the improvement, at the time of this project, to be \$2,350,000, exclusive of amounts previously appropriated.

The amount expended under this project up to June 30, 1907, was \$2,341,749.57 (of which \$237,921.04 was for maintenance), which, added to the amount previously expended, gives a total expenditure for this work of \$3,274,249.57.

A refundment of \$3,942.13 and a total of \$8.90 received from sale of unserviceable property have been received and deposited to the credit of the appropriation.

By this expenditure two stone jetties have been constructed and a seagoing dredge provided, which together have produced a navigable channel with a controlling depth of 24 feet at mean low water, or 5 feet more than called for by the project.

All work done during the fiscal year was for maintenance, and consisted of the following: A complete survey of the entrance was made and examinations made of the ship channel between the jetties and plant and property cared for. The dike on Cumberland Island (constructed for the protection of the inner end of the north jetty) was raised for a distance of 250 feet where settlement had occurred. The cut-off in Beach Creek, begun in May, 1906, was completed in July, 1906, which work has changed the course of the creek away from the dike and prevents undermining of the same.

On June 30, 1907, the ship channel alongside the north jetty had a general depth of 24 feet at mean low water. The controlling depth was 23.5 feet at mean low water on a small lump in the channel. However, by reason of the encroachment upon it of Pelican shoal and the Middle Ground shoal this channel was rather crooked in several places and somewhat difficult to navigate by deep-draft vessels. The encroachment of these shoals upon the ship channel is due to the large amount of sand which comes through the north jetty by reason of the numerous voids and openings in the jetty, occasioned by the use of large stone in its construction.

The mean rise and fall of tide is 6 feet.

The project for the improvement of Cumberland Sound was reported as completed in the Annual Report of the Chief of Engineers for 1905, page 1287.

It is proposed to apply the available balance toward raising the low places in the north and south jetties to high-water mark, filling voids and openings in the north jetty, and constructing a mound at the outer end of the north jetty, for such repairs to the dike on Cumberland Island and for such dredging in the jetty channel as may become necessary.

The additional work proposed is for extension of benefits.

As Cumberland Sound merely constitutes the ocean entrance to Fernandina Harbor the commerce is practically the same as that for Fernandina, and since the harbor of Fernandina is now a special work of improvement the commerce is given under that head.

The effect of the improvement has been to cause a reduction in freight rates of from 25 to 40 per cent.

A list of the Annual Reports of the Chief of Engineers and of executive documents containing the various projects, history of the work, maps, etc., may be found printed on page 288 of the Annual Report of the Chief of Engineers for 1905.

Reference to reports on examination and survey of Fernandina Harbor, ordered by the river and harbor act of March 3, 1905, will be found on page 312 of the Annual Report of the Chief of Engineers for 1906.

July 1, 1906, balance unexpended-----	\$48,846.60
Amount received from refundment-----	.33
Amount received from proceeds sale of Government property-----	8.90
Amount appropriated by river and harbor act approved March 2, 1907-----	75,000.00
	<hr/>
	123,855.83
June 30, 1907, amount expended during fiscal year, for maintenance of improvement-----	6,654.37
	<hr/>
July 1, 1907, balance unexpended-----	117,201.46
July 1, 1907, outstanding liabilities-----	1,204.23
	<hr/>
July 1, 1907, balance available-----	115,997.23

(See Appendix O 10.)

11. *Fernandina Harbor, Florida.*—As will be seen from Coast Survey chart No. 453, the lower end of Amelia River forms a deep basin opposite the city of Fernandina, which portion of the river is known as Fernandina Harbor. The lower end of the harbor connects with Cumberland Sound and is 2 miles from the bar. The harbor is about 1,300 feet in width at the entrance and about 2 miles long. It embraces about 160 acres of well-sheltered anchorage ground, with a depth greater than 25 feet at mean low water, but is somewhat obstructed by small shoals. Above this basin there exists a shoal some 4,000 feet in length, with low-water depths over same ranging from 14 to 18 feet. Above this shoal the river separates into two estuaries, which carry deep water for about 2 miles.

A project providing for such extensions of the depth and width of the channel in front of the town of Fernandina as will meet the requirements of commerce will be found printed as House Document No. 388, Fifty-ninth Congress, first session.

The improvement proposed consists in dredging a channel with widths varying from 400 to 600 feet and depths from 20 to 24 feet at mean low water, in front of and to a short distance above (southwest of) the city of Fernandina. The estimated first cost of this work is \$115,000, with \$15,000 at periods of every two or three years for maintenance after completion.

This project was adopted by act of Congress approved March 2, 1907, which appropriated \$115,000 for its completion.

Specifications for doing the necessary dredging have been distributed and bids are to be opened July 1, 1907.

The work will probably be begun early in the ensuing fiscal year.

No funds have been expended during the fiscal year.

Before the improvement of Cumberland Sound (in 1879), which constitutes the ocean entrance to Fernandina Harbor, the annual in and out bound tonnage at Fernandina was about 300,000, and the value of imports and exports estimated at about \$2,500,000. The commerce of the port during the calendar year 1906 amounted to 955,478 tons, with a value of about \$14,496,135. The chief articles of export are lumber, phosphate rock, and naval stores.

The effect of the improvement of Cumberland Sound has been to cause a reduction in freight rates of from 25 to 40 per cent. It can not now be said what further effect the improvement of Fernandina Harbor will have upon these rates.

Amount appropriated by river and harbor act approved March 2, 1907 -----		\$115,000.00
July 1, 1907, balance unexpended -----		115,000.00
July 1, 1907, outstanding liabilities -----		858.00
July 1, 1907, balance available -----		114,142.00

(See Appendix O 11.)

12. *Removing sunken vessels or craft obstructing or endangering navigation.*—Authority was given for the removal of the wreck of the American schooner *Arthur C. Wade*, sunk in Savannah Harbor, opposite Quarantine, and \$6,000 was allotted for doing the work. The wreck was removed by hired labor, with the use of the U. S. snag boat *Tugaloo*, but the exact cost of the removal has not yet been ascertained and reported.

(See Appendix O 12.)

#### EXAMINATIONS AND SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT APPROVED MARCH 3, 1905.

Reports on preliminary examinations and survey required by the river and harbor act of March 3, 1905, of the following localities within this district were duly submitted by the district officer. They were reviewed by the Board of Engineers for Rivers and Harbors, pursuant to law, and were transmitted to Congress and printed in documents as indicated:

1. *Preliminary examination and survey of Oconee River, Georgia, from the Georgia Railroad bridge to northern boundary of Greene County.*—Reports dated May 26, 1905, and October 18, 1906, are printed in House Document No. 263, Fifty-ninth Congress, second session. A plan for improvement at an estimated cost of \$12,000, and \$1,000 annually for maintenance, is presented.

2. *Preliminary examination of Oconee River, Georgia, from the Georgia Railroad bridge at Milledgeville to the Central of Georgia Railway bridge at Oconee station, Washington County, and survey of Oconee River below the highway bridge at Milledgeville.*—Reports dated July 12, 1905, and October 17, 1906, respectively, are printed in House Document No. 264, Fifty-ninth Congress, second session. Improvement of this locality, except in accordance with the existing project, is not deemed advisable.

## IMPROVEMENT OF CERTAIN RIVERS AND HARBORS IN FLORIDA.

This district was in the charge of Maj. Francis R. Shunk, Corps of Engineers, to August 8 and since October 10, 1906, and in the temporary charge of Lieut. Col. Dan C. Kingman, Corps of Engineers, from August 8 to October 10, 1906. Division engineer, Lieut. Col. Dan C. Kingman, Corps of Engineers.

1. *St. Johns River, Florida.*—This work includes the improvement of the bar at the river mouth and the improvement of the channel from the bar to Jacksonville, a distance of 27.5 miles. Before improvement there was a varying channel across the bar, sometimes 5, sometimes 7 feet deep, and shifting in location through a north and south range of 1 mile. Between the bar and Jacksonville the channel had a least mean low-water depth (at Dames Point) of 11.5 feet.

The range of tide is 5.22 feet at the bar, 4.5 feet at Mayport, 1.8 feet at Dames Point, and 1 foot at Jacksonville.

The first project of improvement, adopted in 1879, contemplated a channel 15 feet deep at mean low water from Jacksonville to the ocean. This was to be obtained by dredging and building training walls in the river and by building two stone jetties converging upon the bar, 1,600 feet apart at their outer ends. Under this project the sum of \$1,417,000 was expended. As a result the bar channel was fixed and deepened to 13 feet, and the river channel was deepened to 16.5 feet.

The present project, adopted in 1896 and modified in 1903, contemplates a channel from Jacksonville to the ocean 300 feet wide and 24 feet deep, except at Dames Point, where the width is to be 400 feet and the depth 25 feet. This channel is to be obtained by dredging and building training walls in the river and by raising and extending the jetties. The estimated cost is \$2,109,750. For work under this project the river and harbor act of 1902 appropriated \$350,000 and authorized an additional amount of \$950,000 for continuing contract. Of these moneys the expenditure of \$150,000 was authorized for the purchase or building of a seagoing suction dredge. For completing the project the river and harbor act of 1905 appropriated \$100,000 and authorized \$309,750 additional for continuing contract, which was made available by the act of 1906. The act of 1907 appropriated \$100,000 for maintenance of the improvement.

The funds thus appropriated have been expended in building a seagoing suction dredge (*St. Johns*) and a river dredge (*Jacksonville*); in dredging, both by contract and by hired labor, using Government plant; in building training walls, and in raising and extending the jetties. The total expended to June 30, 1907, was \$2,121,783.01, of which \$106,361.64 was for work of maintenance and \$175,175.99 was for construction of seagoing dredge. As a result, a channel of the dimensions contemplated by the project has been obtained everywhere but at Trout Creek, where a small amount of rock remains to be excavated. Shoaling has, however, taken place at a few places, necessitating work of maintenance. As a result of the expenditure for maintenance, the channel has been restored to its full dimensions where shoaling had taken place, and low places in the jetties have been built up, increasing the scour over the bar.

The project is about 99 per cent completed.

Were it not for the improvement, freight rates from Florida to northern points would be 50 per cent greater than they are.

The St. Johns River is navigable from the mouth to Lake Washington, a distance of 276 miles, but for deep-draft vessels only as far as Jacksonville, 27.5 miles.

It is proposed to apply the available balance to work of maintenance.

The estimated value of the commerce for 1906 is \$55,000,000.

Tonnage by years: 1898, 494,474; 1899, 816,477; 1900, 649,221; 1901, 700,179; 1902, 903,191; 1903, 1,052,076; 1904, 1,000,316; 1905, 1,406,647; 1906, 2,455,101.

More detailed information may be found in Reports of the Chief of Engineers for 1895, pages 1586-1604; 1896, pages 1305-1312; 1898, pages 1327-1330; 1904, pages 1685-1690; 1905, pages 1291-1295, and 1906, pages 1215-1218.

July 1, 1906, balance unexpended.....	\$322, 292. 83
Amount appropriated by river and harbor act approved March 2, 1907.....	100, 000. 00
Amount allotted appropriations for emergencies in river and harbor acts of June 13, 1902, and March 3, 1905.....	12, 339. 02
Refundment of overpayment.....	2. 00
Receipts from sales.....	767. 85
Amount received, damage to Government property.....	450. 00

435, 851. 70

June 30, 1907, amount expended during fiscal year:

For works of improvement.....	\$251, 441. 09
For maintenance of improvement.....	71, 413. 48
	322, 854. 57

July 1, 1907, balance unexpended.....	112, 997. 13
July 1, 1907, outstanding liabilities.....	36, 745. 16

July 1, 1907, balance available.....	76, 251. 97
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July 1, 1907, amount covered by uncompleted contracts.....	35, 326. 43
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(See Appendix P 1.)

2. *St. Johns River, Florida, opposite the city of Jacksonville.*—The project for improving St. Johns River from Jacksonville to the ocean provides for a channel 24 feet deep. Between the navigable channel and the pierhead lines at the city of Jacksonville the depths are in many places considerably less than 24 feet. A project for securing a depth of 24 feet at mean low water from the existing channel to the pierhead line on the left bank of the river, between the Florida East Coast Railway bridge and Hogans Creek, was adopted by the river and harbor act of March 2, 1907. The estimated cost is \$371,500. The work has not yet begun.

Further information is contained in House Document No. 663, Fifty-ninth Congress, first session.

Amount appropriated by river and harbor act approved March 2, 1907.....	\$371, 500. 00
July 1, 1907, balance unexpended.....	371, 500. 00

(See Appendix P 2.)

3. *St. Johns River at Orange Mills flats, Florida.*—The object of this work is to obtain a 13-foot channel at mean low water from Jacksonville to Palatka. Before improvement there were four shoals,



all near Orange Mills, of less depth than 13 feet. These were Forrester's Point shoal, least depth 11.6 feet; Orange Mills flats, 9.8 feet; Racey Point shoal, 10.1 feet; and Toccoi shoal, 11.1 feet.

The mean range of tide is 0.9 foot. The annual variation of water stage is about 3 feet.

The project, adopted in 1898, is to dredge a channel 200 feet wide and 13 feet deep through the shoals between Jacksonville and Palatka. The estimated cost (raised in 1906) is \$185,000.

The total expenditure to June 30, 1907, was \$93,769.26. The result has been to secure at all shoals a channel 13 feet deep at mean low water, but not of full width. The project is about 57 per cent completed.

The river is navigable to Lake Washington, a distance of 276 miles.

The existence of the St. Johns waterway has probably had an important effect in keeping down freight rates, but the increase of the channel depth to 13 feet has not, so far as known, caused any change in rates.

It is proposed to apply the balance available to the widening of the present channels to 200 feet.

For more detailed information see Report of the Chief of Engineers for 1898, pages 1344-1348; for 1901, page 1738; for 1904, pages 1690-1691.

The commerce of the upper St. Johns is chiefly in lumber, shingles, building material, and general merchandise.

*Tonnage by years.*—1898, 25,866; 1899, 122,074; 1900, 171,500; 1901, 67,500; 1902, 137,950; 1903, 269,610; 1906, 559,838.

July 1, 1906, balance unexpended.....	\$1,365.74
Amount appropriated by river and harbor act approved March 2, 1907.....	25,000.00

26,365.74

June 30, 1907, amount expended during fiscal year, for works of improvement .....	135.00
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July 1, 1907, balance unexpended.....	26,230.74
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Amount (estimated) required for completion of existing project....	65,000.00
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(See Appendix P 3.)

4. *Volusia bar, Florida.*—The object of this improvement is to secure a channel 5 feet deep at mean low water from Palatka to Sanford. Before improvement the channel at Volusia bar was very crooked, and its least low-water depth varied between 3.5 and 4.5 feet.

The project, adopted in 1879 and modified in 1882 and 1887, provided for the construction of two converging jetties, and for dredging, in order to secure a depth of 5 feet at mean low water, at an estimated cost of \$25,000.

The project was completed in 1887 and additional work required is for maintenance. As shoaling is continual, it has been found necessary to dredge from time to time in order to maintain the requisite depth.

The total expenditure up to June 30, 1907, was \$38,489.97, of which \$13,489.97 was for work of maintenance. As a result, there is now a channel from Palatka to Sanford of a least depth of about 4½ feet at mean low stage. As a result of the expenditure for maintenance, the channel in many places has been restored to its original dimen-

sions where shoaling had taken place. Work of maintenance is now in progress.

The usual variation of water level is 2 feet; the extreme variation,  $3\frac{1}{2}$  to 5 feet.

The existence of the St. Johns waterway has probably had an important effect in keeping down freight rates, but the increase of the channel depth to 6 feet has not, so far as known, caused any change in freight rates.

For more detailed information see Report of Chief of Engineers for 1896, pages 1313-1314; for 1897, page 1550; for 1905, page 1296.

The commerce in this portion of the river is chiefly in grain, fertilizers, ship stores, vegetables, and general merchandise. The estimated value of the commerce for 1905 is \$4,260,300.

*Tonnage by years.*—1898, 21,959; 1899, 26,358; 1900, 31,511; 1901, 32,437; 1902, 53,678; 1903, 55,922; 1904, 60,347; 1905, 111,162; 1906, 412,703.

Amount appropriated by river and harbor act approved March 2, 1907. \$2,000. 00

Amount allotted appropriation for emergencies in river and harbor act of March 3, 1905.....	5,000. 00
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7,000. 00

June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	1,489. 97
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July 1, 1907, balance unexpended.....	5,510. 03
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July 1, 1907, outstanding liabilities.....	1,629. 37
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July 1, 1907, balance available.....	3,880. 66
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(See Appendix P 4.)

5. *Oklawaha River, Florida.*—Before improvement this river was obstructed by snags, accumulation of drift, and overhanging trees.

The project adopted in 1891 is to clear the river of obstructions, so as to give a navigable channel 4 feet deep at mean low stage from the mouth to Leesburg, a distance of 94 miles, at an estimated cost of \$26,000. The project was modified by the river and harbor act of March 2, 1907, which adopted a project for removing obstructions and deepening the channel to 6 feet at mean low water from the mouth to and including Silver Springs Run at an estimated cost of \$15,000. This project is printed in House Document No. 782, Fifty-ninth Congress, first session.

Up to June 30, 1907, the total expenditure under this project was \$25,931.66, of which \$14,000 was for work of maintenance. All work has been confined to the lower 62 miles of the river. From the nature of the country, obstructions recur and must be periodically removed.

As a general result there is now a good channel 4 feet deep from the mouth for 21 miles, and a practicable channel of the same depth as far as Silver Springs Run, a distance of 53 miles from the mouth. The river is navigable for very light-draft boats to Leesburg, a distance of 94 miles.

As a result of the expenditure for maintenance, shoal places have been dredged and many snags and overhanging trees removed.

The original project is 40 per cent completed.

During freshets the water sometimes rises to a height of 4 feet above its normal stage.

The improvement has had no appreciable effect upon freight rates.

The commerce concerned is small. The boats using the river are chiefly excursion steamers, which run during the winter months.

*Tonnage by years.*—1898, 4,481; 1899, 4,291; 1900, 4,847; 1901, 4,530; 1906, 9,298.

For further information see Report of Chief of Engineers for 1896, pages 1314–1316; for 1905, page 1298.

Amount appropriated by river and harbor act approved March 2, 1907.	\$15,000.00
June 30, 1907, amount expended during fiscal year, for works of improvement	1,931.66

July 1, 1907, balance unexpended	13,068.34
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Amount (estimated) required for completion of existing project	1,000.00
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(See Appendix P 5.)

6. *Indian River, Florida, between Goat Creek and Jupiter Inlet.*—Indian River is a narrow sound between the coast and an outlying fringe of islands. Before improvement the ruling depth was 2.5 feet. The tide is negligible.

The project adopted in 1891 provides for a continuous channel between Goat Creek and Jupiter Inlet 5 feet deep at mean low water and at least 75 feet wide in the straight reaches, with as much greater width as may be required in the turns. The estimated cost is \$14,000.

The total expenditure up to June 30, 1907, was \$36,686.86. As a result there is now a channel nowhere less than 50 feet wide and 5 feet deep between Goat Creek and Jupiter Inlet. The project is 80 per cent completed.

The improvement has had no effect upon freight rates.

It is expected that the available balance will be applied to work of dredging in continuation of the project and for maintenance.

The commerce of Indian River is small. No statistics are available for 1906. The waterway is used only by launches, small local steamers, and sailing vessels.

For history, description, and project see Report of Chief of Engineers for 1896, pages 1318–1320; for 1905, page 1299; 1906, page 1220.

*Tonnage by years.*—1901, 66,593; 1902, 91,875.

July 1, 1906, balance unexpended	\$2,218.38
Amount appropriated by river and harbor act approved March 2, 1907.	9,000.00

11,218.38

June 30, 1907, amount expended during fiscal year, for works of improvement	1,890.62
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July 1, 1907, balance unexpended	9,327.76
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(See Appendix P 6.)

7. *Biscayne Bay, Florida.*—Before improvement, Biscayne Bay was navigable for boats drawing less than 3 feet of water. There was a channel, excavated at private expense, 12.5 miles long with a least depth of 10.5 feet, from Miami to the Atlantic Ocean near Cape Florida. The tidal range in the bay is about 1 foot.

The river and harbor act of June 13, 1902, adopted in part a plan proposed by a Board of Engineer officers appointed in accordance

with a provision in the river and harbor act of March 3, 1899. This plan contemplated a channel 18 feet deep from the wharves at Miami to the sea by way of a line entering the sea at a point about 4,000 feet north of Norris Cut, and a refuge basin of same depth, 1,200 feet long and 400 feet wide, in some suitable place, this channel to be protected by one or two jetties, as might be found necessary. The estimated cost of the entire improvement was \$1,493,743. (See H. Doc. No. 662, 56th Cong., 1st sess.) The act of 1902 appropriated and authorized an expenditure of \$300,000 for part of this work, and provided that the Florida East Coast Railway Company should construct, at its own expense, a basin 1,600 feet long and 500 feet wide adjacent to the wharves at Miami and the channel from said basin to the east side of the proposed refuge basin on the east side of the bay; that the amounts appropriated and authorized by Congress should be expended in constructing and protecting the portion of the channel extending to the sea from the terminus of the channel to be constructed by the railway company, of such approximately uniform depth and of such width as would best serve the interest of navigation and as could be constructed with the funds appropriated and authorized. The act further provided that before any part of the appropriation should be expended the said railway company should enter into a contract with the United States for the performance of its part of the work. The act authorized work by continuing contract.

The act of March 2, 1907, modified the project by prescribing a width of 100 feet for the dredged channel, and by providing for a jetty on the southern side of the entrance. The total estimated cost of the work authorized by Congress is \$546,000, of which \$146,000 remains to be appropriated under contract authorization of 1907.

The total expenditure up to June 30, 1907, was \$207,643.98, of which \$9,759.17 was for emergency work of shore revetment. As a result there is now a depth of 10 feet across the bay and the northern jetty is completed.

It is expected that the available balance and the additional amount provided for by the act of March 2, 1907, will be applied to work of dredging in completion of the project, extending the north breakwater, and building a breakwater on the southern side of the entrance.

The project is about 36 per cent completed.

In view of the probable completion of a deep-water channel in the near future, a schooner line has been established between Miami and New York, which carries freight at considerably lower rates than are charged by the railroad.

A description of the bay, with report and recommendations of a Board of officers, may be found in Report of the Chief of Engineers for 1900, pages 1986 to 2013. (See also Report for 1905, pp. 1300-1302.)

The commerce of Biscayne Bay is in cattle, fertilizers, lumber, fruits, vegetables, grain, and general merchandise. Estimated value for 1906, \$1,100,000.

Tonnage by years: 1899, 18,089; 1902, 8,390; 1903, 13,319; 1904, 16,788; 1905, 40,700; 1906, 56,405.

July 1, 1906, balance unexpended.....	\$113, 766. 29
Amount appropriated by river and harbor act approved March 2, 1907.....	100, 000. 00
	<hr/> 213, 766. 29

June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$11, 174. 79
For maintenance of improvement.....	175. 00
Balance deposited, emergencies in river and harbor works.....	240. 83
	<hr/> 11, 590. 62

July 1, 1907, balance unexpended.....	202, 115. 67
July 1, 1907, outstanding liabilities.....	12, 579. 51

July 1, 1907, balance available.....	<hr/> 189, 536. 16
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July 1, 1907, amount covered by uncompleted contracts.....	80, 107. 47
Amount (estimated) required for completion of existing project.....	<hr/> 146, 000. 00

{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907.....	146, 000. 00	
		Submitted in compliance with requirements of sundry civil act of June 4, 1897.

(See Appendix P 7.)

8. *Harbor at Key West, Fla., and entrance thereto.*—The entrance referred to is the northwest channel. While Key West Harbor accommodates vessels drawing about 27 feet, the ruling depth over the northwest bar, before improvement, was 10.5 feet at mean low water. The main tidal range is 2.6 feet.

The project adopted in 1889 contemplated a channel 17 feet deep at mean low water. This was to be secured by building two stone jetties, one to the northeast and one to the west of the channel, converging toward the bar, and by dredging, if necessary. The estimated cost of the east jetty was \$500,000. No estimate was made of the entire project.

The act of March 2, 1907, modified the project by authorizing continuance of work on the existing jetties, or the building of training walls, in the discretion of the Secretary of War.

The total expenditure to June 30, 1907, was \$513,509.80, of which \$2,500 was for survey, \$360,000 for work on jetties, \$70,989.18 for work of dredging, and \$80,000 for construction of a seagoing suction dredge. As a result, the east jetty is about 50 per cent completed and the west jetty about 20 per cent, the seagoing suction dredge is completed, and a channel has been dredged having a least depth of 17 feet at mean low water over the northwest bar and a width of 100 feet. The maximum draft that could be carried on June 30, 1907, was 15.5 feet at mean low water.

It is proposed to apply the available balance to dredging and to work on jetties or training walls, as may be decided by the Secretary of War.

The existence of the northwest channel has an important effect upon freight rates between Key West and Tampa. There has been no perceptible change on account of the work of deepening.

The commerce is chiefly in cattle, fertilizers, tobacco, sponges, and general merchandise. The estimated value for 1905 is \$6,536,335.

Commercial statistics for the past year are not at present available.

Tonnage by years: 1898, 72,968; 1899, 130,713; 1900, 30,594; 1901, 18,863; 1902, 14,146; 1903, 134,043; 1904, 174,305; 1905, 132,774.

For further information see Report of Chief of Engineers for 1896, pages 1325-1327; for 1898, page 1371; for 1900, page 1983; for 1904, page 1738; for 1905, page 1302; for 1906, page 1223.

July 1, 1906, balance unexpended-----	\$10, 572. 77
Amount appropriated by river and harbor act approved March 2, 1907-----	200, 000. 00
Money value property lost by employee-----	51. 87
Refundment of overpayment paid prior to July 1, 1906-----	. 10

210, 624. 74

June 30, 1907, amount expended during fiscal year:

For works of improvement-----	\$11, 560. 45
By Treasury settlement 44497, accounts of Major Sanford-----	20. 62

11, 581. 07

July 1, 1907, balance unexpended-----	199, 043. 67
July 1, 1907, outstanding liabilities-----	324. 08

July 1, 1907, balance available-----	198, 719. 50
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Amount (estimated) required for completion of existing project---- Unknown.

(See Appendix P 8.)

9. *Kissimmee River, Florida.*—Before improvement the Kissimmee River was tortuous, shallow, and obstructed by snags and overhanging trees. At ordinary stages the least depth was about 2 feet, and in dry seasons navigation was altogether suspended. Canals had been made through some of the worst bends by private enterprise.

The project, adopted June 13, 1902, provided for a channel 30 to 60 feet wide and 3 feet deep at ordinary low-water stages in the Kissimmee River (including the connecting canals and lakes) from the town of Kissimmee to Fort Bassinger, and for a channel 25 feet wide and 3 feet deep in Istokpoga Creek. The estimated cost of the improvement was \$24,220.90.

The amount expended upon the work of the existing project to June 30, 1907, was \$16,264.39, of which \$1,258 was for maintenance.

As a result there is a channel 3 feet deep for 30 miles south from the head of navigation, and the project is 67 per cent completed.

The maximum draft that can be carried at ordinary low-water stage is 15 inches. The annual variation of level of water surface is about 4 feet.

The town of Kissimmee is at the head of navigation. The entire route from Kissimmee to Fort Bassinger, 99½ miles, is navigable.

The commerce of Kissimmee River is in lumber, cattle, fish, naval stores, fruits, vegetables, and general merchandise. The value of the commerce for the year 1906 was \$310,303.

Tonnage by years: 1901, 3,670; 1902, 9,655; 1903, 10,652; 1904, 2,863; 1905, 9,911; 1906, 10,111.

The project has lowered freight rates by enabling the steamboats to run more months in a year than they did formerly. Freight is hauled by wagons when steamboats are not running, as there are no railroads in the vicinity.

For reference to examination and survey, see page 289, Report of the Chief of Engineers for 1904.

It is proposed to apply the available balance to dredging, bulk-heading, and removal of obstructions in order to extend the 3-foot channel to Fort Bassinger, and to dredge shoal places and trim overhanging trees in Istokpoga Creek.

The work proposed is partly for extension of benefits and partly to make the improvement available.

July 1, 1906, balance unexpended.....	\$94. 53
Amount appropriated by river and harbor act approved March 2, 1907.....	12, 221. 00
	<hr/> 12, 315. 53

June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$815. 92
For maintenance of improvement.....	543. 00
	<hr/> 1, 358. 92

July 1, 1907, balance unexpended.....	10, 956. 61
July 1, 1907, outstanding liabilities.....	1, 972. 87

July 1, 1907, balance available.....	8, 983. 74
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(See Appendix P 9.)

10. *Orange River, Charlotte Harbor, and Caloosahatchee River, Florida.*—These works were consolidated by the act of June 13, 1902.

(a) *Orange River.*—Before improvement the least depth was 2.5 feet at mean low water, and the channel was obstructed by snags and overhanging trees.

The project, adopted June 13, 1902, provides for a channel 50 feet wide and 4 feet deep at mean low water from the mouth of the river to the head of navigation. The estimated cost was \$2,500.

The total expenditure up to June 30, 1907, was \$3,000, of which \$1,000 was for work of maintenance.

The project was completed in 1903, but dredging and snagging will be necessary from time to time.

There is now a navigable channel 4 feet deep from the mouth of the river to the head of navigation.

The maximum draft that can be carried at mean low water is 4 feet. The mean rise and fall of tide is 1 foot. The annual variation of water level on account of freshets is about 2 feet.

The head of navigation is the iron bridge at Buckingham,  $5\frac{3}{4}$  miles from the mouth of the river.

The commerce of Orange River is in fruit, vegetables, fertilizers, lumber, and general merchandise. The value of the commerce for the year 1906 was \$363,331.

Tonnage by years: 1896, 1,250; 1902, 7,155; 1903, 8,555; 1904, 3,099; 1905, 2,074; 1906, 6,258.

The freight rates are practically the same as before the improvement was made.

For reference to examination and survey, see page 291, Report of Chief of Engineers for 1904.

Amount allotted from appropriation by river and harbor act approved	
March 2, 1907.....	\$1, 000. 00
July 1, 1907, balance unexpended.....	1, 000. 00

(b) *Charlotte Harbor and Caloosahatchee River from Puntarasa to Punta Gorda.*—This project was completed in 1903, and no further work is proposed. The amount expended is \$106,000.

(c) *Caloosahatchee River between Puntarasa and Fort Thompson.*—Before improvement there was a navigable channel with a least depth of 5 feet at mean low water from Puntarasa to Fort Myers, and thence with a least depth of 3.5 feet to Fort Thompson. The upper river was obstructed by snags and overhanging trees.

The project, adopted in 1882 and modified in 1886 and 1888, provided for a channel 100 feet wide and 7 feet deep at mean low water from the mouth to Fort Myers, for a channel 4 feet deep at mean low water across the shoal at Beautiful Island, and for snagging and cutting trees on the upper river.

The project was completed in 1901, at a total cost of \$33,600; the results contemplated were obtained.

Since that time \$5,836.10 has been expended in work of maintenance. As a result there is a channel 4 feet deep from Fort Myers to Fort Thompson.

This channel is at present obstructed by snags and overhanging trees.

The maximum draft that could be carried on June 30, 1907, was 7 feet from the river entrance to Fort Myers and thence 4 feet to Fort Thompson. The mean rise and fall of tide at the river entrance is 1.6 feet. During freshets the water level in the upper reaches of the river rises considerably. The head of navigation is Fort Thompson. The navigable portion of the river from the mouth to Fort Thompson is 59.5 miles long.

The commerce of Caloosahatchee River is in fruits, vegetables, lumber, and general merchandise. The value of the commerce for the year 1906 was \$2,146,400.

Tonnage by years: 1899, 33,101; 1900, 22,737; 1902, 27,895; 1903, 27,576; 1904, 12,255; 1905, 9,577; 1906, 22,265.

The constant influx of settlers and the rapid increase of cultivated acreage is partly if not wholly attributable to the improvement of the river.

No change in the nature of the commerce has resulted from the improvement. The freight rates are practically the same as before the improvement was made.

Reference to report on examination ordered by the river and harbor act of March 3, 1905, will be found on page 332 of the Annual Report of the Chief of Engineers for 1906.

Amount allotted from appropriation by river and harbor act approved	
March 2, 1907.....	\$2, 000. 00
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	336. 10
July 1, 1907, balance unexpended.....	1, 663. 90
July 1, 1907, outstanding liabilities.....	917. 81
July 1, 1907, balance available.....	746. 09



## CONSOLIDATED.

Amount appropriated by river and harbor act approved March 2, 1907.	\$3,000.00
June 30, 1907, amount expended during fiscal year, for maintenance of improvement	336.10
July 1, 1907, balance unexpended	2,663.90
July 1, 1907, outstanding liabilities	917.81
July 1, 1907, balance available	1,746.09

(See Appendix P 10.)

11. *Sarasota Bay, Florida.*—Before improvement there was a navigable channel in Sarasota Bay with least depth of 5 feet at mean low water, except at two shoals, where the depths were 4.3 and 3.5 feet, respectively. Little Sarasota Bay had a channel with a least depth of 1.2 feet at mean low water, except at one shoal which was bare at low water.

The project, adopted in 1889, provides for a channel 100 feet wide and 5 feet deep at mean low water from Tampa Bay to Sarasota at an estimated cost of \$17,500.

The sum of \$10,000 had been expended under this project when it was modified (in 1896) to include a channel 75 feet wide and 3 feet deep in Little Sarasota Bay from Sarasota to Caseys Pass. The estimated cost of completion of the entire project was \$45,000, making a total estimate of \$55,000.

The river and harbor act of March 2, 1907, provides for continuing improvement from Tampa Bay to Venice, \$22,500. Venice is about 2 miles southeasterly from Caseys Pass. No survey of the intervening waters has ever been made. The addition of this work necessitates an increase of \$15,000 in the estimated cost of the project.

The total expenditure up to June 30, 1907, was \$36,304.42, of which \$8,714.66 was for work of maintenance.

The project, as modified by the river and harbor act of March 2, 1907, is about 42 per cent completed.

As a result there is a channel 50 feet wide, 5 feet deep at mean low water, from Tampa Bay to Sarasota, and thence 3 feet deep to Blackburns Point.

The maximum draft that could be carried on June 30, 1906, was 5 feet to Sarasota and 3 feet to the southerly end of the dredged cut near Blackburns Point. Mean rise and fall of the tide is 1.5 feet. The navigable channel from the northerly entrance to Blackburns Point is  $33\frac{3}{4}$  miles long.

The commerce of Sarasota Bay is in fruits, vegetables, fish, naval stores, lumber, and general merchandise. The value of the commerce for the year 1906 was \$641,645.

Tonnage by years: 1899, 9,424; 1902, 4,313; 1903, 4,755; 1904, 25,479; 1905, 8,556; 1906, 12,010.

The freight rates have been lowered 25 to 50 per cent, depending on freight classification, since the improvement was undertaken.

For reference to examination and survey see page 293, Report of Chief of Engineers for 1904.

July 1, 1906, balance unexpended.....	\$4, 902. 91
Amount appropriated by river and harbor act approved March 2, 1907.....	22, 500. 00
Receipts from sales.....	40. 75
	<hr/>
	27, 443. 66
June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$3, 804. 42
For maintenance of improvement.....	4, 902. 91
	<hr/>
	8, 707. 33
July 1, 1907, balance unexpended.....	18, 736. 33
July 1, 1907, outstanding liabilities .....	2, 489. 64
	<hr/>
July 1, 1907, balance available.....	16, 246. 69
	<hr/>
Amount (estimated) required for completion of existing project.....	15, 000. 00
(See Appendix P 11.)	

12. *Manatee River, Florida.*—Before improvement, there was a least depth of 9 feet at mean low water over the bar at the river mouth; thence to Palmetto the least depth was about 6 feet; thence to Bradentown about 3 feet; thence to Ellenton 7 feet; thence to Rocky Bluff 6 feet; thence to Rye  $1\frac{1}{2}$  feet.

The first project, adopted in 1882, contemplated a channel 100 feet wide and 13 feet deep at mean low water from Tampa Bay to Shaw and McNeills points, a distance of 4 miles. This was changed in 1886 so as to provide for a channel 100 feet wide and 8 feet deep from Tampa Bay to Manatee, a distance of 9 miles.

The total expenditure under this project was \$34,000.

In 1892 a new project was adopted, reverting to the original plan of a channel 13 feet deep and 100 feet wide to Shaw and McNeills points. The estimated cost was \$39,000. The sum of \$12,000 was expended under this project.

As a result of work under all these projects, a channel was obtained 100 feet wide and 9 feet deep to Bradentown, thence 8 feet deep to Manatee.

In 1897 a project was adopted for a cut-off to Terraceia Bay, at an estimated cost of \$20,000. This was completed to a width of 100 feet and a depth of 6 feet at mean low water, for a total expenditure of \$13,342.

The present project, adopted March 3, 1905, provides for a channel 100 feet wide and 9 feet deep from McNeills Point to Rocky Bluff, and a channel 75 feet wide and 4 feet deep from Rocky Bluff to Rye. The estimated cost is \$53,710.

The total expenditure on the present project up to June 30, 1907, was \$11,829.04. There is now a channel 100 feet wide and 7 feet deep at mean low water as far as Rocky Bluff, thence 75 feet wide and 4 feet deep to Rye.

A maximum draft of 9 feet at mean low water could be carried to Bradentown, 8 feet to Ellenton, 7 feet to Rocky Bluff, and 4 feet to Rye, on June 30, 1906, and 6 feet through Terraceia Cut-off.

Mean rise and fall of tides at Manatee River entrance is 1.6 feet. The annual variation of water surface in the upper river on account of freshets is about 3 feet.

The head of navigation is Rye, and length of the navigable channel is 20 miles.

The commerce of the river is in fruits, vegetables, fuller's earth, lumber, naval stores, and general merchandise. The value of the commerce for the year 1906 was \$3,671,541.

Tonnage by years: 1898, 23,800; 1899, 43,542; 1900, 55,162; 1902, 34,495; 1903, 44,367; 1904, 46,517; 1905, 49,644; 1906, 88,153.

Freight rates have not materially changed as a result of the improvement.

For report of examination and survey made in 1902, see pages 1749-1756, Report of Chief of Engineers for 1904.

It is proposed to apply the available balance to dredging in order to complete the project, and to maintenance.

The present project was 30 per cent completed on June 30, 1907.

The work proposed will be partly for extension of benefits and partly to keep the improvement available.

July 1, 1906, balance unexpended.....	\$231. 17
Amount appropriated by river and harbor act approved March 2, 1907.....	70, 710. 00
	<hr/>
	70, 941. 17
June 30, 1907, amount expended during fiscal year, for works of improvement .....	2, 051. 41
	<hr/>
July 1, 1907, balance unexpended.....	68, 889. 76
July 1, 1907, outstanding liabilities.....	420. 77
	<hr/>
July 1, 1907, balance available .....	68, 468. 99

(See Appendix P 12.)

13. *Tampa Bay, Florida.*—Before improvement the least depth between the Gulf of Mexico and Port Tampa was 13 feet.

The first project, adopted August 11, 1888, contemplated a channel 200 feet wide and 20 feet deep at mean low water from Tampa Bay to Old Tampa Bay. The estimated cost was \$63,000. Prior to this work was carried on in connection with improvement of Hillsboro Bay.

The total expenditure under this project was \$50,000.

A new project was adopted March 3, 1899. It provided for a channel 27 feet deep at mean low water from the Gulf of Mexico to Port Tampa, 500 feet wide across the bar and 300 feet wide in bay, a channel of full width and 24 feet deep to be first secured, and subsequently deepened. The estimated cost was \$750,000.

The total expenditure under this project was \$345,045.80. As a result a channel was formed 128 to 300 feet wide, with a least depth of 24 feet at mean low water.

The project was modified March 3, 1905, by reducing the proposed depth to 26 feet and by providing that no expenditure should be made until the owners of the terminals at Tampa Bay should by valid contract agree that the wharfage charges at such terminals should be submitted for approval to the Secretary of War. A schedule of such charges was approved by the Secretary of War on October 26, 1906.

The amount expended under the revised project to June 30, 1907, was \$35,767.73, including contingent expenses and completion of the U. S. dredge *Key West*.

The modified project is 8 per cent completed.

The maximum draft that can be carried at mean low water is 24 feet. Mean rise and fall of tide at Tampa Bay entrance is 1.5 feet and at Port Tampa 2 feet.

The head of navigation for 24-foot draft is Port Tampa, 35 miles from deep water in the Gulf of Mexico.

The commerce is in phosphate, lumber, coal, crude petroleum, tobacco, grain, and general merchandise. The value of commerce for the year 1906 was \$30,551,511.

Tonnage by years: 1896, 276,638; 1898, 236,136; 1899, 238,305; 1900, 350,761; 1901, 416,503; 1902, 462,703; 1903, 435,867; 1904, 591,181; 1905, 604,131; 1906, 838,378.

The freight rates have been lowered 20 per cent on phosphate shipments since the improvement was undertaken.

It is proposed to expend the available balance in dredging. The proposed work is for extension of benefits.

For report of examination and survey of Tampa Bay see Report of Chief of Engineers for 1897, page 1596 et seq.

July 1, 1906, balance unexpended .....	\$261, 134. 00
Receipts from sales .....	. 95
	<hr/> 261, 134. 95
June 30, 1907, amount expended during fiscal year, for works of improvement .....	31, 934. 77
	<hr/>
July 1, 1907, balance unexpended .....	229, 200. 18
July 1, 1907, outstanding liabilities .....	2, 911. 11
	<hr/>
July 1, 1907, balance available .....	226, 289. 07

(See Appendix P 13.)

14. *Hillsboro Bay, Florida.*—Before improvement the channel from deep water in Hillsboro Bay to the city of Tampa was narrow and tortuous, with least depth of about 4 feet at mean low water.

The first project, adopted in 1880, provided for a channel 9 feet deep at mean low water, 150 feet wide in the bay and 200 feet wide in Hillsboro River. In 1888 the proposed depth was reduced to 8 feet. This project was practically completed in 1893, at a cost of \$80,000.

A second project, adopted March 3, 1899, contemplated a channel 12 feet deep at mean low water, 150 feet wide in the bay and 200 feet wide in the river, from the 12-foot contour in the bay to a point 100 feet south of the Lafayette Street Bridge in Hillsboro River. The estimated cost was \$300,000. The total expenditure under this project was \$275,000. The project was completed, except that the width in the river was only 100 feet and a small part of the bay channel was not of full width.

The present project was adopted March 3, 1905. It contemplates a channel 20 feet deep at mean low water and 150 feet wide from the lower bay to the mouth of Hillsboro River, with a turning basin at the inner end 450 feet wide and 1,050 feet long. The estimated cost is \$448,350.

The total expenditure up to June 30, 1907, under this project was \$299,990.05.

The project is 88 per cent completed.

The turning basin is finished except for a small quantity of rock in the upper end, and 37,335 feet of the channel was completed.

The maximum draft that can be carried through Hillsboro Bay to the head of navigation is 12 feet at mean low water.

Mean rise and fall of the tide is 2.2 feet.

The commerce of Hillsboro Bay is in fruits, vegetables, lumber, coal, cattle, fish, naval stores, fertilizers, fuller's earth, tobacco, and general merchandise. The value of the commerce for the year 1906 was \$18,857,177.

Tonnage, by years: 1898, 32,070; 1899, 87,740; 1900, 96,029; 1901, 131,208; 1902, 169,844; 1903, 228,252; 1904, 274,399; 1905, 307,460; 1906, 450,056.

The freight rates by water have been lowered about 25 per cent since the improvement was undertaken.

For reference to examination and survey see page 295 of Report of Chief of Engineers for 1904.

It is proposed to expend the available balance for completion of the project.

July 1, 1906, balance unexpended	\$357, 440. 41
Receipts from sales	2. 90
	<hr/> 357, 443. 31
June 30, 1907, amount expended during fiscal year, for works of improvement	209, 065. 72
	<hr/> July 1, 1907, balance unexpended 148, 377. 59
July 1, 1907, outstanding liabilities	25, 974. 98
	<hr/> July 1, 1907, balance available 122, 402. 61
	<hr/> <hr/> July 1, 1907, amount covered by uncompleted contracts 54, 494. 29

(See Appendix P 14.)

15. *Crystal, Anclote, and Suwanee rivers, Florida.*—These works were consolidated by the act of June 13, 1902, and included Manatee and Withlacoochee rivers. The river and harbor act of March 3, 1905, made separate provision for Manatee River, and the act of March 2, 1907, made separate provision for Withlacoochee River.

(a) *Crystal River.*—Before improvement the channel from the Gulf of Mexico to the town of Crystal River was tortuous and shallow, the least depth being 2.7 feet at mean low water. The entrance to the river was obstructed by reefs and sand bars.

The project, adopted June 13, 1902, contemplates a channel 60 feet wide and 6 feet deep at mean low water from the Gulf to the town of Crystal River. The estimated cost is \$84,647.46.

The total expenditure to June 30, 1907, was \$22,700, of which \$2,700 was for completion of the dredge *Florida*.

The project was completed on December 6, 1906.

The maximum draft that can be carried at mean low water is 6 feet. Mean rise and fall of the tide is 2.3 feet.

The town of Crystal River is at the head of navigation, and the length of the navigable channel is 9 miles.

The commerce of Crystal River is in lumber, pencil cedar, oysters, fish, and general merchandise. The value of the commerce for the year 1906 was \$159,170.

Tonnage, by years: 1902, 1,785; 1903, 725; 1904, 6,875; 1905, 7,474; 1906, 8,291.

The freight rates have been lowered 10 per cent since the improvement was undertaken.

For reference to examination and survey see page 296 of Report of Chief of Engineers for 1904.

It is proposed to expend the available balance in maintenance.

July 1, 1906, balance unexpended.....	\$14, 636. 22
Amount deposited, rent of dredge <i>Florida</i> .....	206. 72
	<hr/> 14, 842. 94
June 30, 1907, amount expended during fiscal year, for works of improvement .....	12, 336. 22
	<hr/> 2, 506. 72
July 1, 1907, balance unexpended.....	2, 506. 72
July 1, 1907, outstanding liabilities.....	640. 00
	<hr/> 1, 866. 72
July 1, 1907, balance available.....	1, 866. 72

(b) *Anclote River, Florida*.—Before improvement the channel below Tarpon Springs was narrow and tortuous, and obstructed by shoals. The least mean low water depth was 2 feet.

The project, adopted March 3, 1899, contemplates a channel 100 feet wide and 6 feet deep at mean low water from Anclote anchorage to Sponge Harbor and thence 4 feet deep at mean low water to the county bridge at Tarpon Springs. The estimated cost was \$51,500.

The total expenditure to June 30, 1907, was \$20,000. There is now a channel 6 feet deep and 50 feet to 100 feet wide from Anclote anchorage to Sponge Harbor, and a channel 50 feet wide and 4 feet deep from Sponge Harbor to the bridge at Tarpon Springs.

The maximum draft that can be carried at mean low water is 6 feet from Anclote anchorage to Sponge Harbor and thence 4 feet to the county bridge at Tarpon Springs.

The mean rise and fall of tide at Anclote River entrance is 2 feet. The head of navigation is the county bridge at Tarpon Springs. The length of the navigable channel is 5 miles.

The commerce of Anclote River is in sponges, lumber, naval stores, and general merchandise.

Tonnage, by years: 1899, 1,441; 1900, 1,000; 1903, 2,138; 1904, 8,310; 1905, 31,050. No statistics are available for 1906.

The freight rates have been lowered about 20 per cent.

It is proposed to expend the available funds in dredging in continuation of the improvement.

The project was 39 per cent completed at end of the fiscal year.

For reference to examination and survey see page 297 of Report of Chief of Engineers for 1904.

Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	\$17, 000. 00
July 1, 1907, balance unexpended.....	17, 000. 00
July 1, 1907, outstanding liabilities.....	1, 100. 00
	<hr/> 15, 900. 00
July 1, 1907, balance available.....	15, 900. 00
	<hr/> 14, 500. 00
Amount (estimated) required for completion of existing project....	14, 500. 00

(c) *Suwanee River, Florida*.—Before improvement the channel in the Suwanee River was narrow and tortuous, and obstructed by a bar at the entrance and by bowlders, soft rock shoals, snags, and overhanging trees. The least depth at mean low-water stage was 15 inches.

The project, adopted in 1879, provides for a channel 150 feet wide and 5 feet deep from the mouth to Rollands Bluff (75 miles) and thence 60 feet wide and 4 feet deep to Ellaville (60 miles). This is

to be secured by dredging, building wing dams, and snagging. The estimated cost is \$65,158.

The total expenditure up to June 30, 1907, was \$67,836.90, of which \$8,378.76 was for maintenance.

The project was 92 per cent completed on June 30, 1907.

As a result there is now a channel 5.8 feet deep at mean low water and 50 feet wide from the Gulf of Mexico to a distance of one-half mile above the mouth of the river, and thence to Rollands Bluff a channel 5 feet deep at mean low water and 100 feet wide. From Rollands Bluff to Beesons shoal,  $2\frac{1}{2}$  miles below Ellaville, there is a channel 4 feet deep at mean low water and varying from 30 to 100 feet in width.

The maximum draft that can be carried at the river entrance is about 4 feet.

Mean rise and fall of tide at Suwanee River entrance is 2.4 feet. The annual variation of the water surface in upper river on account of freshets is about 5 feet.

The village of Ellaville is at the head of navigation. Length of the navigable channel is 135 miles.

The commerce of Suwanee River is in lumber, naval stores, and general merchandise. The value of the commerce for the year 1904 was \$468,557.

Tonnage, by years: 1898, 106,346; 1899, 76,878; 1904, 7,658.

The commercial statistics for the calendar year 1906 are not available.

The improvement has had no effect on freight rates. Only three steamers now operate on the river occasionally.

It is proposed to expend the available funds in dredging.

The proposed work is for extension of benefits.

July 1, 1906, balance unexpended.....	\$8, 278. 76
Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	8, 000. 00
	<hr/> 16, 278. 76
June 30, 1907, amount expended during fiscal year, for maintenance of improvement .....	8, 378. 76
	<hr/> 7, 900. 00
July 1, 1907, balance unexpended.....	7, 900. 00

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July 1, 1906, balance unexpended.....	\$22, 914. 98
Amount appropriated by river and harbor act approved March 2, 1907.....	25, 000. 00
Received for rent of dredge <i>Florida</i> .....	206. 72
	<hr/> 48, 121. 70
June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$12, 336. 22
For maintenance of improvement.....	8, 378. 76
	<hr/> 20, 714. 98
July 1, 1907, balance unexpended.....	27, 406. 72
July 1, 1907, outstanding liabilities.....	1, 740. 00
	<hr/> 25, 666. 72
July 1, 1907, balance available.....	25, 666. 72
Amount (estimated) required for completion of existing project.....	14, 500. 00

(See Appendix P 15.)

16. *Withlacoochee River, Florida*.—Before improvement the entrance to the Withlacoochee River was crooked and obstructed by reefs. The least depth at mean low water was about 3 feet. Vessels loaded and discharged at an anchorage (called the loading pool) about 9 miles from the entrance. Inside the mouth there was a depth of 7 to 8 feet as far as Inglis, a distance of 9 miles.

The original project, adopted in 1879, provided for a channel having an available depth of 2 feet during about half the year from the mouth of the river to Pembertons Ferry, a distance of 77 miles, and was completed in 1892, at a cost of \$24,403.62. A balance of \$296.38, together with \$5,000 from the consolidated appropriation made by the river and harbor act of 1902, was applied to the construction of the dredge *Florida*.

A project adopted June 13, 1902, provided for straightening the channel from the loading pool to the river mouth and deepening it to 8 feet, and for work of maintenance.

The amount expended to June 30, 1907, was \$30,000.41. As a result there is now a channel with a least depth of 7.8 feet at mean low water and a least width of 60 feet through the most obstructive shoals.

No work has been done during the fiscal year and no money expended.

A good deal of dredging has been done by the Port Inglis Terminal Company, under permission granted by the Secretary of War.

The present project, adopted by the river and harbor act of March 2, 1907, provides for a channel 100 feet wide and 10 feet deep at mean low water from Port Inglis to the anchorage in the Gulf of Mexico, at an estimated cost of \$215,400, and \$5,000 annually for maintenance. The act authorized continuing contracts for completing the work in the sum of \$150,000, which is yet to be appropriated.

The mean rise and fall of tide at Withlacoochee River entrance is 2.8 feet. The annual variation of water surface in the upper river on account of freshets is about 6 feet.

The head of navigation is Pembertons Ferry.

Length of the navigable channel from the loading pool in the Gulf of Mexico to Port Inglis, at mouth of the river, is 9 miles; thence up the river to Inglis, 9 miles; thence to Pembertons Ferry, 68 miles.

The commerce of Withlacoochee River is in phosphate, lumber, coal, iron pyrites, and general merchandise. Port Inglis, at mouth of the river, is a subport of entry. Vessels ply regularly from the anchorage basin off the river entrance to European ports with cargoes of phosphate.

The value of the commerce for 1906 was \$1,977,628.

Tonnage, by years: 1899, 4,941; 1900, 2,550; 1902, 74,047; 1903, 115,269; 1904, 123,369; 1905, 249,884; 1906, 181,226.

The freight rates have been reduced about 30 per cent since the improvement was begun.

It is proposed to expend the available funds for dredging. The additional appropriation asked for is for works of improvement in furtherance of the project.



For improvement of the river, see Report of Chief of Engineers for 1904, pages 298-299 and 1710-1711.

For report on preliminary examination and survey authorized by the river and harbor act of March 3, 1905, see House Document No. 483, Fifty-ninth Congress, second session.

Amount appropriated by river and harbor act approved March 2,

1907-----	\$65,400.00
July 1, 1907, balance unexpended-----	65,400.00
Amount (estimated) required for completion of existing project----	150,000.00

{	Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance un-	150,000.00
	expended July 1, 1907-----	
	Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

(See Appendix P 16.)

17. *Removing the water hyacinth from Florida waters.*—Before improvement many Florida rivers, especially the St. Johns and its tributaries, were badly obstructed by packs of hyacinths. The first project, adopted March 3, 1899, provided for the construction of a boat and booms, and for destroying the water hyacinths by crushing. The estimated cost was \$36,000, plus an undetermined amount for annual expenditure. Nothing was done under this project, as experience in Louisiana showed that destruction by crushing was impracticable.

In 1902 a new project was adopted, providing for the destruction of the hyacinths by any means whatsoever. The plan adopted under this project was to spray the plants with an arsenical compound. The estimated cost was \$50,000 per annum.

Under this project the sum of \$84,977.97 was expended. A steamer was purchased and fitted up for spraying, and the main stream of the St. Johns River and a number of tributaries were cleared of hyacinths.

The act of 1905 modified the project by prohibiting any process injurious to cattle. The plan consequently adopted is to close inlets, sloughs, etc., with booms, to break up the packs with a suitable boat, and propel them into the current in order that they may float away.

The total amount expended up to June 30, 1907, was \$101,336.24. As a result, in addition to results of experiments, 11 miles of the Withlacoochee River and 15 miles of the Kissimmee River have been cleared of hyacinths.

It is expected that the available balance will be expended in removing the hyacinth from the navigable streams of Florida.

For further information see Reports of the Chief of Engineers for 1899, pages 1612-1623; for 1901, pages 1746-1749; for 1903, pages 1184-1186; for 1904, pages 1712-1713; for 1905, page 1318; for 1906, pages 1224-1225.

July 1, 1906, balance unexpended-----	\$18,582. 82
Amount appropriated by river and harbor act approved March 2, 1907--	15,000. 00
Receipts from sales-----	8. 00
	<hr/>
	33,590. 82
June 30, 1907, amount expended during fiscal year, for works of im- provement-----	8,919. 06
	<hr/>
July 1, 1907, balance unexpended-----	24,671. 76
July 1, 1907, outstanding liabilities-----	811. 58
	<hr/>
July 1, 1907, balance available-----	23,860. 18
(See Appendix P 17.)	

18. *Removing sunken vessels or craft obstructing or endangering navigation.*—On June 30, 1906, the sum of \$1,200 was allotted from the indefinite appropriation for removing an obstructive wreck from the channel of St. Johns River, Florida, near Pilot Town front range beacon. Contract for the work was entered into on October 12, 1906, with Chas. W. Johnston, of Lewes, Del. The contract price was \$1,073. The work of removal began November 20 and was completed December 4. Total cost, including incidentals, \$1,200.

On September 18, 1906, the sum of \$600 was allotted for removing a sunken scow from Hillsboro River, near foot of Sixth avenue, Tampa, Fla. The work of removal was done by hired labor, using the U. S. dredge and snag boat *Swanée*. Operations began November 16 and were completed December 8, 1906. The total cost, including incidentals, was \$600.

On March 5, 1907, the sum of \$500 was allotted for removing sunken logs and pieces of armored cable from Hillsboro River between the Atlantic Coast Line and Fortune Street bridges, Tampa, Fla. The obstructions were removed by hired labor, using the U. S. dredge and snag boat *Swanée*. The work began March 27 and was completed April 8, 1907. The total cost, including incidentals, was \$500.

#### EXAMINATION AND SURVEY MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF MARCH 3, 1905.

Reports dated July 24, 1905, and December 29, 1906, on preliminary examination and survey required by the river and harbor act approved March 3, 1905, of *Withlacoochee River, Florida, from Port Inglis to the anchorage in the Gulf, with a view of straightening the channel and making it one hundred feet in width and ten feet in depth*, were submitted by the district officer and were reviewed by the Board of Engineers for Rivers and Harbors, pursuant to law. They were transmitted to Congress and printed in House Document No. 483, Fifty-ninth Congress, second session. A plan is presented for improvement at an estimated cost of \$215,400, with \$5,000 annually for maintenance after completion.

#### IMPROVEMENT OF RIVERS AND HARBORS IN WESTERN GEORGIA AND FLORIDA AND IN EASTERN ALABAMA.

This district was in the charge of Capt. J. B. Cavanaugh, Corps of Engineers, to September 14, and since November 1, 1906, and in the temporary charge of Maj. W. E. Craighill and Maj. Henry Jervay, Corps of Engineers, from September 14 to November 1, 1906. Divi-

sion engineer, Lieut Col. Clinton B. Sears, Corps of Engineers, to July 16, 1906, and Col. E. H. Ruffner, Corps of Engineers, since that date.

1. *East Pass and Carrabelle bar and harbor, Florida.*—The town of Carrabelle is situated at the mouth of Carrabelle River, which empties into St. George Sound. The river forms the inner harbor and along the water front its channel varies from 9 to 14 feet in depth, with a minimum width of about 100 feet.

Dog Island anchorage, a protected portion of St. George Sound, showing a 4-fathom depth over a considerable area, forms the outer harbor. Between the 10-foot contours in the inner and outer harbors there is a bar about 6,000 feet wide, which originally had a minimum low-water depth over it of  $3\frac{1}{2}$  feet to 4 feet.

Dog Island anchorage is connected with the Gulf of Mexico by East Pass, which had originally limiting low-water depths of about 17 feet on the outer bar and 16.5 feet on the inner bar.

The approved project for Carrabelle bar and harbor, Florida, adopted June 3, 1896, provides for dredging a channel 10 feet deep and 100 feet wide from Dog Island anchorage, St. George Sound, to the city of Carrabelle, at a cost estimated in 1900 at \$47,300, in addition to appropriations already expended on the project amounting to \$22,399.54. By act of Congress approved June 13, 1902, this project was extended to include the improvement of East Pass by dredging a channel across the bar  $20\frac{1}{2}$  feet deep and 150 feet wide and closing an opening in Dog Island, at an estimated cost of \$27,450.

This project is about 30 per cent completed.

By act of Congress approved March 2, 1907, the project was further extended to include a channel 18 feet deep and 100 feet wide from the 18-foot contour in the outer harbor to a point opposite the beacon situated about 1,000 feet up the river from its mouth, with a suitable turning basin, but the size of the basin was not fixed by Congress, and the estimated cost of the extension of the project has not been determined.

The amount expended up to close of the fiscal year ending June 30, 1907, was \$66,712.95, of which \$21,704.08 was expended prior to estimate of 1900, and about \$17,500 has been applied to maintenance.

The channel at the mouth of the river has been partially dredged from time to time, and during 1906 it was completed to a width of 100 feet and a depth of 10 feet from the wharves at Carrabelle to a point 1,400 feet south of the red beacon, and also widened 100 feet at the turn opposite Timber Island, but it has since shoaled at the inner end. The remaining part of the channel has a depth of 10 feet for a width of about 80 feet, and the maximum draft that could be carried through the channel to the inner harbor on June 30, 1907, was about 8 feet.

The channel is still crooked at the inner end and the sharp turn around the black beacon should be eliminated by moving this beacon and cutting off the eastern end of Timber Island.

The shoaling of this channel is believed to be due largely to storm action, and it should be protected to the eastward. This will be largely accomplished by the work which the Georgia, Florida and Alabama Railway Company is to undertake in the near future.

In 1904 the channel across the outer bar was deepened by dredging from about 17 to 20 feet, and across the inner bar from about

16.5 feet to 17.5 feet, this limiting depth being confined to a short distance.

As the crooked channel through the cross over and around the inner bar is about  $1\frac{1}{2}$  feet deeper than the dredged channel, the limiting depth through East Pass on June 30, 1907, was 19 feet at mean low water.

The ordinary range of tide is about 2 feet.

The commerce of the port of Carrabelle, Fla., consists principally of timber, naval stores, dressed and kiln-dried lumber, shingles, fish, oysters, and general merchandise, and for the year ending June 30, 1907, it is estimated at 40,000 tons, valued at \$540,000.

With the completion of the project, a substantial reduction in ocean rates may be expected, due to increased draft and improved facilities for lighterage, and a further reduction on freight handled by rail should result from the improvements projected by the Georgia, Florida and Alabama Railway Company in connection with the 18-foot channel and turning basin.

Reference to reports on examinations and surveys of this harbor will be found on pages 333 and 355 of Report of the Chief of Engineers for 1906.

July 1, 1906, balance unexpended.....	\$8, 105. 87
Amount appropriated by river and harbor act approved March 2, 1907.....	60, 000. 00
	<hr/> 68, 105. 87

June 30, 1907, amount expended during fiscal year:

For works of improvement.....	\$3, 114. 74
For maintenance of improvement.....	2, 500. 00
	<hr/> 5, 614. 74

July 1, 1907, balance unexpended.....	62, 491. 13
July 1, 1907, outstanding liabilities.....	1, 545. 88
	<hr/> 60, 945. 25

July 1, 1907, balance available.....	60, 945. 25
Amount (estimated) required for completion of existing project.....	40, 000. 00

(See Appendix Q 1.)

2. *Harbor at Apalachicola Bay, Florida.*—The town of Apalachicola lies at the mouth of the Apalachicola River, and the deep water along the river front forms the inner harbor.

At the mouth of the river, between the inner harbor and the 3-fathom anchorage area in Apalachicola Bay, there is a bar of which the original width between 8-foot contours was 7,000 feet and the minimum depth of water 3.5 feet. Across this bar the lumber exported is lightered either to the 3-fathom anchorage in Apalachicola Bay or through Bulkhead shoals to the anchorage of Carrabelle, 25 miles distant. The 3-fathom anchorage area is entered via West Pass, where originally the depth was about 13 feet. The original depth over Bulkhead shoals was less than 4 feet.

The original project, adopted June 14, 1880, provided for dredging a channel 100 feet wide and 11 feet deep through the bar at the mouth of the river, the width of cut to be increased to 200 feet if the results justified this enlargement.

This project was amended September 19, 1890, to include dredging a channel 9 feet deep and not less than 100 feet wide across the Bulkhead shoals.

Upon this project as amended has been expended \$154,000, of which \$100,000 has been applied to maintenance in repeated dredging of the cut across the bar at the mouth of the river. The channel through Bulkhead shoals, dredged in 1891-2, remains practically unchanged, with a minimum depth of 8 feet at mean low water.

Prior to the adoption of any project of record in this office \$28,600 was expended on this improvement—1833-1839—but the object and results of such expenditures are unknown.

By act approved March 3, 1899, a new project was adopted, which provided for a channel 100 feet wide, 18 feet deep at mean low water through the West Pass along the northern shore of St. George Island, and across the bay to the water front of Apalachicola, estimated to cost \$350,000, and \$20,000 or \$30,000 annually for maintenance of completed work.

Under this project a channel 80 feet wide and 9 feet deep at mean low water was dredged in 1903 from the mouth of the river to a point 1,047 feet south of the red beacon, and a channel 567 feet long also dredged through the "Oyster Lump" south of this beacon on the line marked by St. George Island light. This channel having shoaled was redredged in 1904 and again in 1906.

In 1900 the channel across the outer bar at the West Pass entrance to Apalachicola Bay was dredged 150 feet wide and 17 feet deep over a distance of 5,280 feet. The channel having shoaled to a depth of 13 feet in 1904, it was relocated and redredged to a minimum depth of 16 feet.

In 1905 Link channel along the north shore of St. George Island was dredged under contract to a depth of 18 feet for a width of 100 feet.

In 1905-6 the U. S. dredge *Charleston* redredged the channel across the outer bar to about 17.6 feet, increased the depth across the inner bar to 16.8 feet, and slightly improved the condition of Link channel.

The amount expended on this project was \$130,679.26, of which about \$90,000 was for maintenance.

By act of Congress approved March 2, 1907, a new project was adopted by which the previous project was amended so as to provide for a channel across the bar at the mouth of the Apalachicola River not less than 100 feet wide and 10 feet deep at mean low water, and a channel not less than 150 feet wide and 18 feet deep through Link channel and West Pass to the Gulf of Mexico, at an estimated cost of \$85,000, and \$17,500 annually for maintenance after completion.

As the excessive fill in this channel is due largely to wave action and cross currents having a strong westerly set, a bulkhead to the eastward will be necessary for proper maintenance.

The hurricane of September 26-27, 1906, seriously damaged the channel across the outer bar at West Pass by extending the shoal at the western end of Sand Island across the dredged cut, filling it and forcing this part of the channel farther to the west.

The ordinary range of the tide is about 2 feet.

The commerce of this port is in timber, cotton, naval stores, staves, a large quantity of dressed and kiln-dried lumber, shingles, laths, and miscellaneous freight, and for the year ending June 30, 1907, it is estimated at 76,000 tons, valued at \$1,240,000.

The opening of West Pass is of great importance and will reduce the rate on foreign and coastwise freight from Apalachicola about 50 cents per ton.

On June 30, 1907, the maximum draft that could safely be carried through the West Pass entrance to the lower anchorage behind St. George Island was about 16 feet and the maximum draft that could be carried across the bar at the mouth of the river about 7 feet.

References to reports on examinations and surveys of this harbor will be found on pages 335 and 355 of Report of the Chief of Engineers for 1906.

July 1, 1906, balance unexpended.....	\$9, 419. 23
Amount appropriated by river and harbor act approved March 2, 1907.....	85, 000. 00
	<hr/> 94, 419. 23
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	9, 598. 40
July 1, 1907, balance unexpended.....	84, 820. 74
July 1, 1907, outstanding liabilities.....	32. 76
	<hr/> 84, 787. 98
Amount (estimated) required for completion of existing project.....	25, 000. 00

(See Appendix Q 2.)

3. *Apalachicola River, Florida, including the Cut-off and lower Chipola River, Florida, and the upper Chipola River from Marianna to its mouth.*—(a) *Apalachicola River, the Cut-off and lower Chipola River.*—From the junction of the Chattahoochee and Flint rivers to the Gulf of Mexico (Apalachicola Bay) the Apalachicola River has a length of about 137 miles and a low-water slope of about 3 inches to the mile. The width varies from 150 to 300 yards and the available depth was originally 6 feet at low water, except where obstructed by snags and sunken logs.

The Confederate authorities obstructed the channel at a point about 47 miles above the mouth, causing the river to break through by a channel known as Moccasin Slough into the River Styx, the latter a tributary entering the Apalachicola a few miles below the Confederate obstructions. Moccasin Slough was very narrow and tortuous and much obstructed by logs, snags, etc., and the former channel has gradually filled up.

About 55 miles above the mouth steamboats may leave the river and after passing through the Cut-off, lower Chipola River, and Lee Slough, reenter it about 17 miles farther down, thus making many landings of much greater importance than those upon the corresponding part of the main river, which includes Moccasin Slough above mentioned.

The original project adopted by the act of June 23, 1874, contemplated securing a channel 100 feet wide and 6 feet deep at low water by the removal of snags and overhanging trees and widening and straightening Moccasin Slough and the Elbows, at an estimated cost of \$80,333.

The act of September 19, 1890, adopted an addition to the project, providing for the clearing of a channel 60 feet wide and 5 feet deep through the Cut-off, Lee Slough, and the lower Chipola River, at a cost of \$7,500.

The amount expended on work under this project since 1874 to the close of the fiscal year ending June 30, 1907, was \$88,038.76. In addition there was expended, between 1828 and 1831, \$13,000, for which no project is of record. These expenditures have improved

Moccasin Slough sufficiently for present purposes and maintained the river reasonably free from snags and other obstructions and enabled steamboats to make use of the Cut-off, lower Chipola River, and Lee Slough either by day or night. An available depth of 6 feet has been secured in the Apalachicola River and 5 feet in the Cut-off, lower Chipola River, and Lee Slough. The Cut-off and Lee Slough have been widened also at the narrowest places so that steamboats can pass through readily going downstream and can pass upstream with little difficulty, but the channel in Lee Slough is still very crooked, with some sharp bends that require easing, and the steamboats prefer the main river on the up trip. It is estimated that the project is over one-half completed.

The work was done with the plant belonging to the Chattahoochee and Flint river improvements, and comprised cutting overhanging timber, removing snags and logs, blasting out cypress stumps, and widening the slough and Cut-off by clearing the points of timber and dredging them off, depositing the dredged material in the deep holes or upon the banks.

During the fiscal year work has been confined to the maintenance of the improvement and a small amount of permanent work in the Cut-off and Lee Slough.

Variation of the water level is from 0 to 30 feet at Chattahoochee River bridge.

This river is navigable throughout its entire length of 137 miles.

As the country bordering on the Apalachicola River is almost entirely dependent upon the river for the transportation of its supplies and products, this improvement is essential to the development of this section, but in the absence of any basis of comparison the effect upon freight rates can not be determined.

The commerce of the river consists chiefly of cotton, naval stores, general merchandise, saw logs, and timber for export, and is so combined with that of the Chattahoochee, Flint, and upper Chipola rivers that a separation is impossible. The commerce of all these streams has increased from about \$4,000,000 in 1899 to about \$14,000,000 in 1907. For detailed statistics, see report on Flint River.

For reference to reports of examinations of this river, see Report of the Chief of Engineers for 1906, page 337.

(b) *Upper Chipola River, Florida, from Marianna to its mouth.*—The river from Marianna to the head of the Dead Lakes has a general low-water depth of 5 feet and width varying from 60 to 200 feet, but is greatly obstructed by rock shoals, snags, and overhanging trees. Three bridges also form obstructions, their headways above low water being 17, 16, and 15 feet, respectively.

At Look and Tremble shoal, about 45 miles above the Dead Lakes, there is a fall of 5 feet in 40 over rock bottom. At Sister Islands, between this shoal and the Dead Lakes, the main channel of the river is very tortuous and obstructed by mud bars over which there is less than 2 feet at low water. The channel through the Dead Lakes, which is considered part of this improvement, has plenty of water, but is obstructed by snags and large cypress stumps and trees.

The approved project, adopted by act of March 3, 1899, provides for clearing a low-water channel 3 feet deep and 60 feet wide from Marianna to the foot of the Dead Lakes, estimated to cost \$41,000,

exclusive of necessary plant, which would comprise a snagboat, drilling barge, and dump scow.

The amount expended to June 30, 1907, was \$12,499, of which \$5,000 was applied to the river above Sister Islands and \$7,499 to the lower end of Dead Lakes. Snags, logs, and overhanging trees were removed, and a channel blasted through the rock reefs from Marianna to Look and Tremble shoal. Wing dams were built below some of the shoals to raise the water level on the shoals, and below Look and Tremble shoal, down as far as Sister Islands, snags, logs, and overhanging timber were removed as well as available funds permitted. From the lower end of the Dead Lakes for a distance of 16 miles a channel 60 feet wide was cleared of obstructions by removing logs, overhanging trees, cypress stumps, and knees. Very little benefit has been derived from the expenditure above Look and Tremble shoal, except to timber industry, but the work done below the shoal and in the Dead Lakes has been of great benefit, as there are many turpentine stills below this shoal, giving a considerable commerce on this portion of the river and in the Dead Lakes a large commerce in towing logs.

The variation of the water level is 0 to 14 feet.

Two feet is the maximum depth at low water over the shoalest part of the river below the shoal Look and Tremble. The actual head of navigation at low water is Sister Islands, 35 miles above the foot of the Dead Lakes.

The river is still obstructed by shoals at Sister Islands, Look and Tremble shoal, and at numerous points above, as well as by the bridges mentioned. The channel below Sister Islands is much obstructed by snags, logs, and overhanging trees, and this same condition exists in the channel through the Dead Lakes, except where improved at the lower end.

The commerce of this stream consists principally of naval stores, round and square timber, lumber, and other miscellaneous freights, the estimated value of which was, on June 30, 1907, \$100,000.

The section of country through which this stream flows is heavily timbered with long-leaf yellow pine and cypress, which is now being rafted down this stream in large quantities. The total amount of this traffic is reported as 10,000,000 feet B. M., and is included in the valuation of timber and lumber exports for Apalachicola Bay and Carrabelle Harbor, Florida.

For reference to report of examination of this stream, see Report of the Chief of Engineers for 1906, page 338.

#### APALACHICOLA RIVER.

July 1, 1906, balance unexpended.....	\$182.43
Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	1,000.00
	<hr/> 1,182.43
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	182.43
	<hr/> 1,000.00
July 1, 1907, balance unexpended.....	1,000.00
July 1, 1907, outstanding liabilities.....	37.16
	<hr/> 962.84
July 1, 1907, balance available.....	



## LOWER CHIPOLA RIVER.

July 1, 1906, balance unexpended-----	\$109.84
Amount allotted from appropriation by river and harbor act approved March 2, 1907-----	15,000.00
Amount allotted from appropriation for emergencies, act of March 3, 1905-----	5,000.00
	<hr/>
	20,109.84
June 30, 1907, amount expended during fiscal year, for maintenance of improvement-----	6,398.60
	<hr/>
July 1, 1907, balance unexpended-----	13,711.24
	<hr/>
Amount (estimated) required for completion of existing project----	5,000.00

## UPPER CHIPOLA RIVER.

July 1, 1906, balance unexpended-----	\$868.94
Amount allotted from appropriation by river and harbor act approved March 2, 1907-----	9,000.00
	<hr/>
	9,868.94
June 30, 1907, amount expended during fiscal year, for maintenance of improvement-----	2,367.94
	<hr/>
July 1, 1907, balance unexpended-----	7,501.00
July 1, 1907, outstanding liabilities-----	824.39
	<hr/>
July 1, 1907, balance available-----	6,676.61
	<hr/>
Amount (estimated) required for completion of existing project----	30,000.00

## CONSOLIDATED.

July 1, 1906, balance unexpended-----	\$1,161.21
Amount appropriated by river and harbor act approved March 2, 1907-----	25,000.00
Amount allotted from appropriation for emergencies, act of March 3, 1905-----	5,000.00
	<hr/>
	31,161.21
June 30, 1907, amount expended during fiscal year, for maintenance of improvement-----	8,948.97
	<hr/>
July 1, 1907, balance unexpended-----	22,212.24
July 1, 1907, outstanding liabilities-----	861.55
	<hr/>
July 1, 1907, balance available-----	21,350.69
	<hr/>
Amount (estimated) required for completion of existing project----	35,000.00

(See Appendix Q 3.)

4. *Flint River, Georgia*.—Originally this river was navigable at low water from its mouth to Bainbridge, a distance of 36 miles, for boats drawing 3 feet, but the channel was narrow, crooked, and greatly obstructed by logs, snags, and overhanging trees. Above Bainbridge the channel was so obstructed by rock shoals, loose rock, and bowlders that there was no navigation except on a rise of 5 feet, when steamboats could run to Albany, 105 miles above the mouth. Above Albany to Montezuma, 182 miles from the mouth, the channel was so obstructed by sand and rock shoals, bowlders, snags, logs, and overhanging trees that the river was not navigable at a low-water stage.

The original project called for a channel 100 feet wide and 3 feet deep at extreme low water from the mouth of the river to Albany, Ga., at an estimated cost of \$184,862.

This project was extended in 1870 to give a channel for light-draft steamers at moderate stages of water from Albany to Montezuma by the removal of logs, snags, and overhanging trees, cutting through rock reefs, and deepening sand bars by contraction works, at an additional cost of \$15,000.

The amount expended up to the close of the fiscal year ending June 30, 1907, was \$251,580.42, practically all being for permanent work. As a result of the work done, the river is now navigable throughout the year from Albany down to a point about 7 miles below Newton, 40 miles, and from Bainbridge to the mouth, 36 miles, there being a good channel with 3 feet available at low water throughout these sections. The project is about 55 per cent completed.

Between Bainbridge and Newton, for a distance of 29 miles, the river is navigable for light-draft boats only, and the channel is narrow and still much obstructed by bowlders and rock reefs. Considerable work has been done between these points, and operations for the next few years will be confined to this portion of the river. When the improvement of this section has been completed the river will be open to navigation at low water from its mouth to Albany, Ga.

The section between Albany and Montezuma, 77 miles, is still much obstructed, although it has been repeatedly cleared of snags and similar obstructions in accordance with the project.

During the past fiscal year 2 miles of channel, from Flat Rock shoals to Sycamore shoal, in the section between Newton and Bainbridge, was improved to a width of 60 feet and a depth of 3 feet.

The water level varies from 0 to 40 feet.

During ordinary low water Albany, Ga., is the head of navigation, but in periods of extreme low water, such as occurred during the fall of 1904, interruptions occur in the section between Bainbridge and Newton.

The commerce consists principally of cotton, naval stores, provisions, general merchandise, saw logs, and timber for export. Several very large sawmills are located at Bainbridge, but no record of the amount of lumber manufactured is kept, as shipments are made by rail. A large part of the saw logs used by these mills comes down the river.

To make the improvement below Albany fully available it will be necessary to widen the channel in many places between Bainbridge and Newton, and to remove many obstructions to secure the width of 60 feet and the depth of 3 feet now available in the section above.

This work is largely permanent rock work, and its completion will greatly benefit the section of country between Albany and the mouth of the river. There are many turpentine stills in operation on the river which depend upon the water transportation for their products and supplies.

The effect of the improvement on freight rates, if any, can not be determined.

The commerce of the lower part of this stream is so combined with that of the Chattahoochee and Apalachicola rivers that it is impossible to give a statement in regard to it. The commerce of that part

below Albany down as far as the improvement has been carried is estimated to be 8,245 tons, valued at \$850,000, for the past fiscal year.

For reference to reports of examination of this improvement see Annual Report of the Chief of Engineers for 1906, page 340.

July 1, 1906, balance unexpended.....	\$14, 626. 98
Amount appropriated by river and harbor act approved March 2, 1907.....	25, 000. 00
	<hr/> 39, 626. 98
June 30, 1907, amount expended during fiscal year :	
For works of improvement.....	\$9, 207. 40
For maintenance of improvement.....	1, 000. 00
	<hr/> 10, 207. 40
July 1, 1907, balance unexpended.....	29, 419. 58
July 1, 1907, outstanding liabilities.....	915. 34
	<hr/> 28, 504. 24
July 1, 1907, balance available.....	<hr/> 62, 500. 00
Amount (estimated) required for completion of existing project.....	
(See Appendix Q 4.)	

5. *Chattahoochee River, Georgia and Alabama, below Columbus.*—Columbus, Ga., is 223 miles above the junction of this river with the Flint and 360 miles above the mouth of the Apalachicola River, formed by the confluence of the Chattahoochee and Flint. Originally boats were always able to reach Columbus, but navigation was difficult and dangerous by day and impossible by night, owing to the large accumulation of logs, snags, and overhanging trees, and to sand, rock, and marl shoals obstructing the channel.

The project for the improvement, adopted in 1873, provided for a low-water channel 100 feet wide and 4 feet deep from Columbus, Ga., to Chattahoochee, Fla., at the junction of the Flint, which was to be obtained by the removal of logs, snags, and overhanging trees, cutting through the rock and marl shoals, and scouring out sand bars by works of contraction and shore protection. The estimated cost of this work from Chattahoochee, Fla., to Eufaula, Ala., 139 miles, was \$145,247, but no estimate of cost for that part between Eufaula and Columbus was ever made.

The amount expended on this work to the close of the fiscal year ending June 30, 1907, was \$571,276.16, largely expended in maintenance, removing the annual influx of obstructions brought in from caving banks. The project is about 60 per cent completed in the upper section, above Eufaula, and about 10 per cent in the lower section.

No increased depth, except in the upper part of the river, has been gained; but by removing the logs, snags, and overhanging trees, removing the sand, gravel, marl, and rock reefs and regulating the channel immediately below Columbus, the river has been kept open to navigation. As nearly all the land along the banks of the river and its tributaries has been gradually cleared, each rainy season has brought increasing quantities of sand into the river, filling the original river bed with shifting sand and gravel bars and greatly changing its regimen. In fact, this stream has now a changeable bed, and it is difficult to predict one year exactly where work will be needed the next. Four feet draft can be carried at ordinary low water, but at extreme low water scant 3 feet is the maximum draft that can be counted upon.

Below Eufaula, Ala., the river is now in a fair condition, with an available low-water depth of  $3\frac{1}{2}$  feet, but between Eufaula and Columbus there are a number of bars and isolated obstructions which cause trouble, particularly at extreme low water. The most serious of these obstructions was a series of sand bars formed in the river from the wharves at Columbus down to Mary Freemans bar, 3 miles below, which made it impossible for steamboats to reach Columbus, and the head of navigation during the period of extreme low water was therefore Mary Freemans bar.

During the last few years more liberal appropriations have permitted a more vigorous prosecution of work, and considerable progress has been made on the permanent improvement of the river. In addition to maintaining the river free from snags and obstructions, the channel for a distance of 20 miles below Columbus has been regulated by a system of jetties, and the most serious bars in the upper river have been kept open by dredging where necessary. As a result of this work, Columbus has become the head of navigation, and boats are able to reach there at all times, except during unusually low water, such as occurred in the fall of 1904, putting a stop to all navigation.

A large number of other sand bars and shoals between Columbus and Eufaula still need improvement, the regulating works already built require repairs and maintenance, and the annual accumulation of snags and other obstructions must be removed from the river throughout its length.

It is proposed to apply the funds available to this work, the regulating works to be extended down the river from the foot of the present permanent improvement.

The variation of the water level is 0 to 47 feet at Columbus.

The commerce of this stream consists of cotton, cotton seed, fertilizers, grain, naval stores, provisions, hardware, and general merchandise, and is so combined with that of the Flint and Apalachicola rivers that a separation is impossible. It is given under the report of the Flint River as 120,900 tons, valued at \$13,510,750.

The effect of improvement has been to give to Columbus and all other points on the river water rates, or a material reduction over rates to all rail points, but the exact amount of reduction can not be stated.

For reference to report of examination of this river see Annual Report of the Chief of Engineers for 1906, page 341.

July 1, 1906, balance unexpended.....	\$25, 112. 28
Amount appropriated by river and harbor act approved March 2, 1907.....	150, 000. 00
Amount allotted from appropriation for emergencies, act of March 3, 1905.....	10, 000. 00
	<hr/>
	185, 112. 28
June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$7, 000. 00
For maintenance of improvement.....	26, 457. 66
	<hr/>
	33, 457. 66
July 1, 1907, balance unexpended.....	151, 654. 62
July 1, 1907, outstanding liabilities.....	7, 497. 31
	<hr/>
July 1, 1907, balance available.....	144, 157. 31
(See Appendix Q 5.)	

6. *Choctawhatchee River, Florida and Alabama.*—The Choctawhatchee River is 162 miles long from Newton, Ala., to its mouth, in Choctawhatchee Bay, an arm of the Gulf of Mexico.

Originally the river was impassable during low water for about 10 miles below Newton, due to marl reefs and fish-trap dams, and for the remaining 152 miles to the mouth it was much obstructed by snags, logs, overhanging trees, and sand and gravel bars.

The project for the improvement, as amended in 1890, contemplates the creation of a low-water navigable channel throughout by removing logs, snags, and overhanging trees, by excavating rock and marl shoals, and by contraction works and shore protection, at an estimated cost of \$112,832.

The amount expended on this river under the existing project (i. e., since 1874) up to the close of the fiscal year ending June 30, 1907, was \$178,600.38, of which the greater part has been expended in maintenance. The expenditures prior to 1874 amounted to \$12,876.62.

The project has been completed and the additional work required is for maintenance.

The following results have been accomplished:

A channel 40 feet wide and 3 feet deep has been blasted through the marl shoals below Newton to the lower end of these shoals above Pates Landing. The river has been partially cleared of snags and other obstructions from Pates Landing to Geneva, but above Pates Landing to the foot of the shoals it is impassable at lower stages of water. A fairly navigable channel  $3\frac{1}{2}$  feet deep at low water was secured by snagging and works of regulation from Geneva to Caryville, but is again much obstructed. The remainder of the lower river has repeatedly been cleared of obstructions, but is at present much obstructed, except the section below the mouth of the Holmes River, which is in fair condition. A channel 75 feet wide and 6 feet deep at mean low water was dredged through the bar at the mouth of the river (Cypress Top).

The actual head of navigation at low water on June 30, 1907, was the mouth of the Holmes River, 33 miles above the mouth of the river. The minimum draft that could be carried to this point was about 3 feet, but the draft is at least 1 foot greater, except at Sandy reach, where trouble has recently developed.

The effect of the improvement on freight rates, if any, can not be stated.

There is no commerce on the river above Geneva, with the possible exception of a small movement of logs. Below Geneva there is a large commerce in logs and hewn timber, and ~~five steamers ply between Pensacola and Vernon on the Holmes River.~~

The commerce on this stream is mainly saw logs, timber, naval stores, and general merchandise, estimated at \$800,000 in value.

For reference to reports on examination of this river, see Annual Report of the Chief of Engineers for 1906, page 343.

## BETWEEN GENEVA AND NEWTON—GENERAL IMPROVEMENT.

July 1, 1906, balance unexpended-----	\$1, 639. 00
Amount appropriated by river and harbor act approved March 2, 1907-----	10, 000. 00
	<hr/> 11, 639. 00
June 30, 1907, amount expended during fiscal year, for maintenance of improvement-----	1, 939. 38
July 1, 1907, balance unexpended-----	9, 699. 62
July 1, 1907, outstanding liabilities-----	54. 55
	<hr/>
July 1, 1907, balance available-----	9, 645. 07

## CYPRESS TOP OUTLET.

July 1, 1906, balance unexpended-----	\$663. 94
June 30, 1907, amount expended during fiscal year, for maintenance of improvement-----	663. 94

(See Appendix Q 6.)

7. *Holmes River, Florida, from Vernon to its mouth.*—Holmes River empties into the Choctawhatchee River about 40 miles above the mouth of the latter. It is a wide and deep stream to the town of Vernon, 25 miles above its mouth, but was originally obstructed by sunken logs, fallen timber, and overhanging trees, and was only available for navigation by small sailing craft and barges, which occasionally made trips up to Vernon.

The present project for the improvement of the stream provides for making a navigable channel by removing logs and snags from the river and overhanging trees from its banks, from the mouth up to the town of Vernon.

The total amount expended on this improvement up to the close of the fiscal year ending June 30, 1907, was \$14,000, of which \$11,839.20 was upon Holmes River and \$2,160.80 upon Lagrange Bayou.

The project has been completed and additional work required is for maintenance.

Prior to June 30, 1902, the channel was cleared of all obstructions that were then found and made available for the small craft that then used the stream. A considerable trade having sprung up on this river, work was resumed during the fall of 1903 and the river cleared of obstructions from Vernon to its mouth. It was again cleared in 1904 and in 1905, and Boyntons bar was improved also by the construction of contracting works.

The importance of this improvement has increased greatly in the last few years, and five steamers are now engaged in the large and growing trade between Vernon and Pensacola.

The commerce of the stream consists of cotton, turpentine, rosin, molasses, honey, and miscellaneous articles, the value of which in 1907 was \$800,000.

For reference to report of examination of this stream, see Annual Report of the Chief of Engineers for 1882, page 1308.

July 1, 1906, balance unexpended.....	\$5. 02
Amount appropriated by river and harbor act approved March 2, 1907.....	2, 000. 00
	<hr/> 2, 005. 02
June 30, 1907, amount expended during fiscal year, for maintenance of improvement .....	5. 02
	<hr/> 2, 000. 00
July 1, 1907, balance unexpended.....	
(See Appendix Q 7.)	

8. *Blackwater River, Florida.*—The original project for this improvement was adopted March 3, 1899, and provided for securing a channel 9 feet deep from Milton, Fla., to Pensacola, Fla., at an estimated cost of \$20,000. Under this project \$5,000 was expended, and a channel of the required depth secured in the river proper.

The river and harbor act of March 3, 1905, fixed the width of the channel at 100 feet and the estimated cost of completion at \$15,000.

With funds appropriated by this act an 8-inch suction dredge and other plant necessary for doing the work were repaired and dredging was commenced in East Bay near the beacon, about 2 miles below Robinsons Point, and a channel about 80 feet wide and not less than 9 feet deep was dredged for a distance of 4,470 feet toward Robinsons Point. This cut has improved the worst part of the channel and increased the available depth over the improvement about 1 foot, and it is estimated that the approved project is about 40 per cent completed. In the execution of this work it has been found that the area to be dredged over is much larger than indicated by the available charts of the improvement, possibly due in part to fill which has taken place since the surveys for the charts were made. To secure a channel 9 feet deep and 100 feet wide over the remaining shoals within the wide limits covered by the improvement is estimated to require \$20,000 in addition to funds available. It is to be noted that in the report upon which the present project is based the doubtful character of the original estimate was recognized and the possibility of a considerable increase was clearly foreseen.

The total amount expended on this improvement up to the close of the fiscal year ending June 30, 1907, was \$16,370.98, of which about \$5,000 was for maintenance.

The maximum draft that could be carried over the improvement at mean low water on June 30, 1907, was 8 feet. The usual variation of water surface is 2 feet. The head of navigation is at Milton, about 4 miles above the mouth of the river proper.

The effect of the improvement on freight rates, if any, can not be stated.

The commerce of this stream consists of timber, lumber, sash and doors, naval stores, wool, and general merchandise, having an estimated value of \$1,350,000 per annum. The dry dock at Bagdad and marine railway at Milton both do a large business, which would be materially increased by the completion of the project.

For reference to report of examination of this improvement, see Annual Report of the Chief of Engineers for 1906, page 345.

July 1, 1906, balance unexpended-----	\$8,911.67
Amount appropriated by river and harbor act approved March 2, 1907-----	5,000.00
	<hr/> 13,911.67
June 30, 1907, amount expended during fiscal year:	
For works of improvement-----	\$7,500.00
For maintenance of improvement-----	2,782.65
	<hr/> 10,282.65
July 1, 1907, balance unexpended-----	3,629.02
July 1, 1907, outstanding liabilities-----	3,120.08
	<hr/> 508.94
July 1, 1907, balance available-----	508.94
Amount (estimated) required for completion of existing project-----	20,000.00
(See Appendix Q 8.)	

9. *Harbor at Pensacola, Fla.*—The available depth across the inner bar at the entrance to this harbor in 1879, previous to any work of improvement, was 19.5 feet, the width of the channel being contracted by the encroachment of the Middle Ground shoal to the southward. The harbor entrance and channel way were also obstructed by wrecks, and the western shore line in the vicinity of Fort McRee was cutting away rapidly, almost the whole of the old Fort McRee washing away before the erosion was stopped.

The project of 1877 considered only the removal of the wrecks; that of 1878 called for the removal of these wrecks and for making a survey to determine further recommendations for improvement. The project of 1881 provided for dredging a channel 300 feet wide and 24 feet deep at mean low water for the temporary relief of navigation, and also for protecting the shore line near Fort McRee, with a view to preventing further injurious changes. Dredging under this project was carried on at various times between 1881 and 1893, and at the close of the dredging operations in August, 1893, the available channel was 225 feet wide and 24 feet deep at mean low water. Two groins, one 360 feet and the other 220 feet long, were completed in 1890 and still serve to hold the shore line near Fort McRee.

In 1891 a special Board of Engineers presented a project for opening a new channel across the Caucus shoal, following the direction of the ebb current, by means of two jetties, assisted by dredging, if necessary. In 1895 a second special Board of Engineers recommended that no change be made in the project of 1891, but that dredging be tried, using one of the hydraulic dredges belonging to the United States to open up a channel 26 feet deep at mean low water and as wide as practicable on the line of deepest water across the Caucus shoal and approximately on the line of the axis of the jettied channel proposed by the Board of Engineers in 1891. In December, 1895, this channel was opened by the U. S. dredge *Gedney* to a width of 120 feet and depth of 24 feet at mean low water. It has a length of about 10,000 feet across Caucus shoal and is now known as the Caucus channel.

In 1896 the same Board that recommended the first amendment to the project of 1891 submitted a second amendment providing for the expenditure of all funds available in continuing the work of dredging across the Caucus shoal and for building a dredge and opening the channel across the Caucus shoal 30 feet deep at mean low water to a



width of at least 300 feet, with such side slopes as the material would assume, if sufficient funds were made available by Congress. Until a channel should be opened by dredging across the Caucus shoal, as above proposed, the Board recommended that the construction of the jetties for its maintenance be not considered.

The river and harbor act of March 3, 1899, extended this project to "securing a channel depth of 30 feet at mean low water, from the Gulf of Mexico to the dock line at the east end of the city of Pensacola."

Work done during the fiscal year ending June 30, 1902, by the U. S. dredge *Comstock*, loaned from the Galveston district, secured a 30-foot depth for a width of 100 feet throughout the center of the channel, and for an additional width of 100 feet a depth of 28 feet was obtained.

The amount expended on these projects to June 30, 1905, was \$725,956.94. The work done comprises the removal of the wrecks obstructing the channel, dredging a large amount of material from the inner bar, opening and redredging a 30-foot channel across the Caucus shoal, and the protection of the shore line from erosion by the construction of two groins near old Fort McRee.

The river and harbor act approved June 13, 1902, appropriated \$220,000, of which \$150,000 might be used in constructing a seagoing suction dredge. This dredge, the *Caucus*, was built and turned over to the district in August, 1905. The same act modified the project, which now provides for dredging a channel 30 feet deep and 500 feet wide from the Gulf of Mexico to the dock line at the east end of the city of Pensacola. There is no approved estimate of the cost of this project. Under this amended project there has been expended, for dredge construction, \$171,378.39, and for the improvement, \$152,144.96, of which about \$100,000 has been applied to maintenance. The project is about 25 per cent completed.

The U. S. dredge *Winyah Bay* was borrowed from the Charleston district, and between August 10, 1904, and February 14, 1905, she restored the channel to a depth of 30 feet at mean low water for a width of 150 feet.

The dredge *Caucus* commenced dredging September 18, 1905, and at the close of the present fiscal year had removed a total of 877,925 cubic yards of material. This work has restored the channel to its original dimensions and widened it to the eastward about 75 feet and removed the greater part of the shoaling due to the September storm, so that on June 30, 1907, the minimum width of channel having a depth not less than 30 feet at mean low water was, approximately, 225 feet.

From October 6, 1906, to January 8, 1907, inclusive, the *Caucus* was employed by the Navy Department on salvage work at the Pensacola Navy-Yard, resulting from the storm of September 26-27, 1906, and on completion of this service she was laid up at the navy yard for repairs. Due to crippled facilities and lack of labor at the yard these repairs were greatly delayed, and dredging was not resumed until May 11, 1907, when the *Caucus* commenced work with one pump, pending completion of repairs to boilers. For the remainder of the fiscal year she was engaged in removing the shoaling due to the storm.

The maximum draft that could be carried over the improvement at mean low water on June 30, 1907, was 30 feet, and the ordinary range of tide is about 1.1 feet.

The commerce of this port is very large. For the fiscal year ending June 30, 1903, the foreign exports were reported as \$13,741,540, no record of the coastwise exports being available; in 1904, as \$15,893,436; in 1905, exports as \$15,295,067 and imports as \$985,840; in 1906, exports as \$18,432,931 and imports as \$386,377; in 1907, exports as \$20,229,414 and imports as \$618,363.

The completion of the project will give greatly increased facilities to the large commerce of Pensacola, but will not materially affect freight rates.

July 1, 1906, balance unexpended.....	\$60,587.54
Amount appropriated by river and harbor act approved March 2, 1907 .....	100,000.00
Amount received for salvage work by dredge <i>Caucus</i> .....	9,799.32
	<hr/>
	170,386.86
June 30, 1907, amount expended during fiscal year:	
For works of improvement..... <sup>a</sup>	\$13,161.10
For maintenance of improvement.....	50,949.79
	<hr/>
	64,110.89
July 1, 1907, balance unexpended.....	<sup>b</sup> 106,275.97
July 1, 1907, outstanding liabilities.....	<sup>b</sup> 8,829.71
	<hr/>
July 1, 1907, balance available.....	<sup>b</sup> 97,446.26
July 1, 1907, amount covered by uncompleted contracts.....	2,747.88
(See Appendix Q 9.)	

10. *Escambia and Conecuh rivers, Florida and Alabama.*—These two names apply to one and the same stream, which flows through a heavily timbered country in southern Alabama and western Florida into Escambia Bay, an arm of Pensacola Bay. The change of name occurs at the boundary line between the two States. The timber from this district is brought down the river and forms a large part of all that is exported from Pensacola. Originally the river was much obstructed by snags, marl reefs, and sand bars, and a bar at its mouth, where the rafts are made ready to be towed to Pensacola, prevented the entrance of tugs and seriously interfered with navigation.

The first appropriation for the improvement of this river was made in 1833, and prior to the adoption of the present project \$5,000 was expended in removing obstructions. A subsequent appropriation of \$5,500, made in 1836, was returned to the surplus fund in 1838. No further appropriations were made until 1880.

(a) *General improvement.*—The present project, as originally adopted June 14, 1880, provided for the improvement of the river from its mouth to Indian Creek, Alabama, an estimated distance of 293 miles, by the removal of snags, logs, and overhanging trees, by excavating rock shoals, by works of contraction and shore protection, and by dredging a channel 150 feet wide and 5½ feet deep at mean low water through the bar at the mouth, all at an estimated cost of \$87,430, but the recent adoption of a separate project for the Conecuh

<sup>a</sup> Includes \$3,161.10 on account of construction of dredge *Caucus*.

<sup>b</sup> Includes \$1,621.61 on account of construction of dredge *Caucus*.

River has, in effect, fixed the upper limit of the improvement as the mouth of Patsaliga Creek. The project has been completed and additional work required is for maintenance.

The amount expended on this project to June 30, 1907, was \$116,998.22, largely for maintenance. These expenditures have kept the river fairly free from snags, opened the channel across the bar at the mouth from time to time, and greatly facilitated the rafting and towing of timber; but, due to lack of funds in recent years, the river, which in 1900 was practically free from obstructions from its mouth to near the mouth of Patsaliga Creek, has again become so much obstructed as to seriously interfere with the rafting of timber at low-water stages. The channel across the bar has shoaled also, interfering with the movement of the towboats for the rafts. In 1905 the worst obstructions were removed from the mouth of Escambia River to a point near Brewton, Ala., about 128 miles above.

During the September storm of 1906 the channel was badly obstructed with fallen timber, and under an emergency allotment of \$5,000, made for the purpose, this was removed by the United States snag boats.

Reference to reports of examination of this improvement will be found on pages 348-349 of the Report of the Chief of Engineers for 1906.

(b) *Conecuh River*.—By act of Congress approved March 2, 1907, a project was adopted for completing the improvement of the Conecuh River from the mouth of Patsaliga Creek to the State line between Florida and Alabama, by removal of bowlders, snags, and rock shoals, in accordance with report submitted in House Document No. 159, Fifty-ninth Congress, first session, at an estimated cost of \$31,000.

Work under this project has been confined to plant, a quarter boat has been constructed, and a working barge is nearing completion. The field work will commence early in the coming fiscal year, and funds now available will be sufficient to complete the project for this section of river. Subsequent maintenance can be more conveniently and logically provided for under the general project.

The actual head of navigation during ordinary stages of the river is at the mouth of Patsaliga Creek, about 195 miles above the mouth of Escambia River.

The effect of the improvement on freight rates, if any, is not known.

The commerce of this stream is mainly in timber, lumber, and saw logs, the value of which is estimated at \$2,500,000.

#### GENERAL IMPROVEMENT.

July 1, 1906, balance unexpended.....	\$4, 278. 83
Amount appropriated by river and harbor act approved March 2, 1907..	15, 000. 00
Amount allotted from appropriation for emergencies, act of March 3, 1905 .....	5, 000. 00
	<hr/> 24, 278. 83
June 30, 1907, amount expended during fiscal year, for maintenance of improvement .....	6, 312. 85
	<hr/>
July 1, 1907, balance unexpended.....	17, 965. 98
July 1, 1907, outstanding liabilities.....	1, 192. 53
	<hr/>
July 1, 1907, balance available.....	16, 773. 45

## CONECUH RIVER.

Amount appropriated by river and harbor act approved March 2, 1907.	\$31, 000. 00
June 30, 1907, amount expended during fiscal year, for works of improvement	964. 20
July 1, 1907, balance unexpended	30, 035. 80
July 1, 1907, outstanding liabilities	899. 33
July 1, 1907, balance available	29, 136. 47

(See Appendix Q 10.)

11. *Alabama River, Alabama.*—This river is formed by the junction of the Coosa and the Tallapoosa, 11 miles below Wetumpka, on the Coosa River, and from this junction to its junction with the Tombigbee to form the Mobile it constitutes a 312-mile link in a waterway 815 miles long, from the Oostenaula and Coosawattee rivers, Georgia, to the Gulf of Mexico.

The river was originally so obstructed by logs, snags, and overhanging trees, and shoals, many with depths of but 2.5 feet, that during the low-water season navigation was practicable by day only. Long detentions were frequent at many of the shoals below Selma, and when the water was unusually low traffic was suspended between Selma and Montgomery for three or four months in the year.

The original project, adopted in 1878, for the improvement of this stream provided for securing a low-water channel 4 feet deep and 200 feet wide by removing snags, logs, and overhanging trees; by constructing works of regulation, and by dredging, all at an estimated cost of \$229,741. On this project \$185,000 was expended, principally in snagging operations and the construction of works of contraction. These expenditures greatly improved the condition of the channel, freeing it from obstructions, and secured a low-water depth of 4½ to 5 feet.

In 1891 the original project was amended to provide for a low-water channel 6 feet deep, which was to be secured in the same general way as contemplated in the original project, and the estimated cost was placed at \$386,251, provided that at least \$100,000 should be appropriated annually, and \$10,000 a year thereafter for maintenance. The project is about 10 per cent completed.

Upon this project there has been expended to June 30, 1907, \$303,659.06, largely for maintenance, but until recently appropriations have been very small and the channel has been deteriorating, work on the river being confined to the operations of the snag boat. During the last two years the plant has been thoroughly overhauled and materially increased, and both the dredge and snag boat operated throughout the working seasons.

The river and harbor act of March 3, 1905, contemplated securing a continuous channel not less than 4 feet deep in the Alabama River by open-channel work, and as the benefits to be derived from the improvement are very great, funds should be provided for the vigorous prosecution of work.

On June 30, 1907, the maximum draft that could be carried to Montgomery at low water was about 3½ feet, but due to unusually favorable conditions for the last year the limiting depth available has been at least 1 foot greater than this. These conditions, however, were very unfavorable for work of improvement last season.

The actual head of navigation is Wetumpka, on the Coosa River, and the variation of the water level is from 0 to 59 feet at Montgomery, Ala.

The commerce of this stream is important, consisting principally of cotton, cotton seed, fertilizer, grain, lumber, shingles, naval stores, staves, and a large quantity of miscellaneous freight of all descriptions, amounting in the past fiscal year to approximately 417,041 tons, valued at \$10,833,488. This, however, is but a part of the freight movement that is affected by the improvement, for the actual shipments by water have been relatively small, and with the river improved for continuous navigation, it is estimated that at least 100,000 tons of the present all-rail freight movement would either go by river or at river rates, and the resulting saving would be enormous. In addition, improved facilities would render possible an actual reduction in rates on freight now carried by river.

For reference to reports of examinations made of this river, see Report of the Chief of Engineers for 1906, pages 340-350.

July 1, 1906, balance unexpended.....	\$61, 626. 50
Amount appropriated by river and harbor act approved March 2, 1907..	200, 000. 00
	<hr/> 261, 626. 50
June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$5, 000. 00
For maintenance of improvement.....	26, 285. 56
	<hr/> 31, 285. 56
July 1, 1907, balance unexpended.....	230, 340. 94
July 1, 1907, outstanding liabilities.....	18, 954. 03
	<hr/> 211, 386. 91
July 1, 1907, balance available.....	<hr/> 211, 386. 91
July 1, 1907, amount covered by uncompleted contracts.....	15, 710. 00

(See Appendix Q 11.)

12. *Coosa, Oostenaula, and Coosawattee rivers, Georgia and Alabama.*—The Coosa is formed at Rome, Ga., by the junction of the Oostenaula and Etowah rivers, which have their sources in northern Georgia. The Oostenaula is formed by the junction of the Coosawattee and Connesauga rivers, 56 miles northwest of Rome. The Oostenaula above Rome, Ga., and its tributary, the Coosawattee, are navigable for light-draft boats during nine months of the year for a distance of about 105 miles, but the Etowah and the Connesauga are not navigable.

The Coosa River has always been navigable for light-draft boats from Rome, Ga., to Greenport, Ala., an estimated distance of 162 miles, and this part of the river is of such a character as to make its improvement by works of contraction and channel excavation entirely practicable, except at Horseleg shoals, near Rome, Ga., where a lock of low lift will be ultimately required.

From Greenport, Ala., to Wetumpka, Ala., a distance of 142 miles, locks and dams are required in conjunction with works of contraction and channel excavation to provide for navigation.

From Wetumpka to the junction of the Tallapoosa River the river is navigable at all seasons.

The ordinary variations of the water surface are, at Rome, Ga., 0 to 30 feet; at Greenport, Ala., 0 to 15 feet; at Wetumpka, Ala., 0 to 50 feet.

The improvement of these rivers is provided for under the three following projects (for reference to report upon proposed modifications of projects for improving the Coosa River, seen Annual Report of the Chief of Engineers for 1905, p. 326):

(a) *Coosa River between Rome, Ga., and East Tennessee, Virginia and Georgia Railroad bridge.*—The original project for the improvement of the Coosa River contemplated the opening of a continuous water route of transportation from the Mississippi River to the Atlantic Ocean by way of the Ohio, Tennessee, Coosa, Etowah, Ocmulgee, and Altamaha rivers, with canals from the Tennessee to the Coosa and from the Etowah to the Ocmulgee. This was designated as the "southern route."

Various examinations and estimates for the improvement of parts of this section of river have been made from time to time up to the adoption of the existing project, September 19, 1890. This project, as modified by act of Congress of July 13, 1892, formed a part of a plan submitted in 1875 for a proposed waterway from the Mississippi to the Atlantic via the Tennessee River, and provides for a crib and timber lock 200 by 32 feet and a 3-foot lift, with excavation for a 4-foot channel between Rome, Ga., and Wills Creek in Alabama, at a total estimated cost of \$180,000; for three locks between Greenport and Lock 4 (Whisenant and Ten Island shoals), 210 feet long, 40 feet wide, and an extreme low-water depth of 4 feet on miter sills, together with a 3-foot channel between Locks 1 and 3, at a total estimated cost, including accessory dams and dikes, of \$155,616.23; for five locks and dams from and including Lock 4 to the East Tennessee, Virginia and Georgia Railroad bridge, the locks to have an available length of 280 feet, width of 52 feet, and an extreme low-water depth of 6 feet over the miter sills, together with a connecting channel 100 feet wide and 4 feet deep at extreme low water, at a total estimated cost of \$1,160,491, or at a total cost for the entire improvement of \$1,496,107.23. About 20 per cent of the project has been completed.

To June 30, 1907, there has been expended on this section of the Coosa \$1,048,438.16, of which \$524,738.16 has been expended upon the existing project and \$523,700 prior to its adoption. The work accomplished is as follows, of which expenditures about 10 per cent has been for maintenance:

Locks 1, 2, and 3, Coosa River, commenced prior to 1890, have been completed. They are situated, respectively, 0.68 mile, 3.86 miles, and 5.24 miles below Greenport, Ala., and have available lengths of 175 feet and widths of 40 feet.

Lock 4 (25.89 miles below Greenport), commenced since the adoption of larger dimensions above mentioned, has, together with its appurtenances, been under construction, with desultory appropriations, since 1886, but still incomplete.

Channel improvement has been extended as far down as Lock 4, and navigation is now possible to this point, except at extreme low water, when interruptions occur a short distance above Lock 4.

During the past fiscal year work was confined to the improvement and maintenance of the channel between Rome, Ga., and Lock 4, Alabama, and to care of the large amount of plant on hand. Provision

should be made for further improvement and maintenance of this channel.

By act approved June 4, 1906, Congress authorized the completion of the dam and fore bay of Lock 4 by private interests, and when this work is undertaken funds should be provided for the completion of the lock, for such completion will afford a passage to the rafts which must at present be run over the dam, frequently injuring it seriously, and will also extend navigation to the railroad at Riverside during the greater part of the year. As the old cofferdam now acting as the west abutment of Dam 4 is in bad condition, extensive repairs will be required in the near future to preserve the dam, and unless advantage is promptly taken of this act these repairs must be undertaken by the United States. However, since the terms of the act allow two years for the commencement of work on the dam and fore bay, no additional appropriation for repairs to the dam or for completion of the lock will be required at present.

On June 30, 1907, the maximum draft that could be carried at ordinary low water between Rome, Ga., and Lock 4 was 3 feet, except at Horseleg shoals,  $1\frac{1}{2}$  miles below Rome, over which but 2 feet can be carried until a lock is constructed at this point.

The improvement has resulted in a reduction in railroad rates between points on the river and either Rome or Gadsden of not less than 50 per cent, water rates controlling all shipments to and from the country contiguous to the river.

The commerce of this portion of the Coosa consists principally of cotton, cotton seed, fertilizer, timber, lumber, staves, grain, and miscellaneous articles, amounting to 124,078 tons, valued at \$3,500,000.

(b) *Coosa River between Wetumpka and East Tennessee, Virginia and Georgia Railroad bridge.*—On account of the numerous rapids this part of the river has never been navigable.

The original project for the improvement of this section of the river, adopted September 19, 1890, as the result of a survey made in 1889 and modified by Congress July 13, 1892, contemplates slack-water navigation and provides for the construction of 23 locks and dams of varying lifts, of an available length of 280 feet and width of 52 feet, with 6 feet over the miter sills, no lift of lock to exceed 15 feet. In addition, the channel is to be cleared of various rock reefs and points so as to give a least depth of 4 feet, all at an estimated cost of \$5,106,422. About 4 per cent of the project has been completed.

There has been expended on this project to June 30, 1907, \$400,423.32, of which about  $2\frac{1}{2}$  per cent has been for maintenance, which has resulted in the construction of the lowest lock of the series, known as No. 31, excepting the dam and gates, the excavation of the channel between this lock and the one next above, and the preparation of data and plans for additional locks and dams, but these data are still incomplete. As yet no benefit has been derived from this improvement, and its value is entirely dependent on the completion of the entire system.

Provision should be made for the care of the property belonging to the improvement.

(c) *Oostenaula and Coosawattee rivers, Georgia.*—There were no operations on these streams during the year, and none are proposed until obstructing bridges are altered.

To June 30, 1907, \$32,656.41 has been expended.

## CONSOLIDATED.

July 1, 1906, balance unexpended-----	\$14, 570. 92
Amount appropriated by river and harbor act approved March 2, 1907-----	50, 000. 00
Amount received from sale of typewriter-----	5. 00
	<hr/> 64, 575. 92
June 30, 1907, amount expended during fiscal year, for maintenance of improvement-----	7, 521. 83
July 1, 1907, balance unexpended-----	57, 054. 09
July 1, 1907, outstanding liabilities-----	2, 297. 61
	<hr/> 54, 756. 48
July 1, 1907, balance available-----	
Amount (estimated) required for completion of existing project--	6, 059, 913. 00
(See Appendix Q 12.)	

13. *Operating and care of canals and other works of navigation on Coosa River, Georgia and Alabama.*—Locks 1, 2, and 3 were opened to navigation June 30, 1890, and have been operated continuously ever since, except during such periods as it was necessary to close them for repairs and for a period of ten days in February, 1895, when the canal between Locks 2 and 3 was frozen over.

The amount expended to the end of the fiscal year ending June 30, 1907, was \$163,759.45.

The expenses of operating and care of Locks 1, 2, and 3 and Dam 4 during the fiscal year have been paid from the permanent indefinite appropriation provided for by section 4 of the act of July 5, 1884. These expenses amounted to \$11,444.11, exclusive of liabilities outstanding on June 30, 1907, of \$7,635.15.

(See Appendix Q 13.)

14. *Removing sunken vessels or craft obstructing or endangering navigation.*—On March 22, 1907, an allotment of \$1,250 was made from the indefinite appropriation for the removal of the wreck of a lighter sunk in Apalachicola River. Bids for removal were opened on June 25, 1907, and the work will be done under contract early in the next fiscal year.

#### IMPROVEMENT OF RIVERS AND HARBORS IN WESTERN ALABAMA AND EASTERN MISSISSIPPI.

This district was in the temporary charge of Capt. J. B. Cavanaugh, Corps of Engineers, to September 13, 1906; in the temporary charge of Maj. W. E. Craighill, Corps of Engineers, from September 14 to October 2, 1906, and in the charge of Maj. Henry Jervey, Corps of Engineers, since October 2, 1906. Division engineer, Lieut. Col. Clinton B. Sears, Corps of Engineers, to July 16, 1906, and Col. E. H. Ruffner, Corps of Engineers, since that date.

1. *Mobile Harbor, Alabama.*—This channel originally had minimum depths of 5½ feet through Choctaw Pass and 8 feet through Dog River bar, the available draft to Mobile, via Spanish River, being limited to the latter depth.

The improvement of the channel of Mobile Harbor has been progressive. Between 1826, the date of the first appropriation for this work, and 1857 a channel 10 feet deep was dredged through the



shoals in Mobile Bay up to the city of Mobile. Between 1870 and 1876 this depth was increased to 13 feet, the channel being dredged to a width of 300 feet through Choctaw Pass and 200 feet through Dog River bar.

In 1880 a project for a channel 17 feet deep and 200 feet wide was adopted, and appropriations between 1878 and 1886 were applied to the formation of a channel of these dimensions.

In the river and harbor act of August 11, 1888, a project for securing a channel 23 feet deep was adopted, this project being modified by the river and harbor act of September 19, 1890, so as to provide for the formation of a channel 23 feet deep and with a top width of 280 feet from the Gulf of Mexico to the mouth of Chickasaw Creek, above the city of Mobile. This channel was completed in 1896, subsequent appropriations, up to and including that made by the sundry civil act of July 1, 1898, having been applied to its maintenance.

The total amount expended on these projects was \$3,648,630.60, of which about \$115,000 is estimated to have been applied to maintenance.

The existing project for the improvement of Mobile Harbor provides for the formation of a channel 23 feet deep and 100 feet wide at bottom, with appropriate slopes, from the entrance of the bay to the mouth of Chickasaw Creek, at an estimated cost of \$1,640,000, and the removal of sunken obstructions from Mobile Harbor at such times as the latter work may be authorized. This project was adopted by the river and harbor act approved March 3, 1899, and was modified by the acts of June 13, 1902, and March 3, 1905.

The amount expended on work under the existing project up to the close of the fiscal year ending June 30, 1907, was \$1,300,584.21, of which amount the sum of \$262,221.75 was allotted to the work of maintenance.

The work of forming a 23-foot channel in Mobile River and Bay under the existing project was commenced in 1899, and under two continuing contracts, during the progress of which 12,402,956 cubic yards of material, scow measurement, was removed up to November 11, 1903, an uninterrupted channel of the projected depth and from 55 to 150 feet width was formed within the limits of the project. Expenditures since have been applied to maintenance dredging. The work of removing sunken trees, logs, timbers, and other dangerous obstructions from the channel of Mobile Harbor has been prosecuted, when necessary, with funds allotted for that purpose.

The project was modified by the river and harbor act of March 2, 1907, so as to include the completion of the work proposed by the existing project at an estimated cost of \$560,000 and the prosecution of operations to provide increased depth progressively as may be possible with appropriations of \$100,000 annually for a period of five years. The act authorized continuing contracts for prosecuting the work in the sum of \$360,000, yet to be appropriated, and the application of \$10,000 to removal of obstructions arising from freshets in the rivers entering Mobile Bay. The construction of a dredge for this improvement was also authorized.

The modified project is printed in House Document No. 647, Fifty-ninth Congress, first session.

With available funds and future appropriations it is proposed to dredge the channel to its full dimensions throughout its length, and to obtain such increase in depth as may be possible; to build a dredge for use on the improvement at a cost not to exceed \$200,000, and to remove sunken logs and similar obstructions from the navigable channel.

Under normal conditions the dredged channel in Mobile Harbor shoals rapidly, but this shoaling during the past fiscal year was added to greatly by the storm of September 27, 1906. From an examination after this storm it was found that there were places with as little as 17 feet depth, and, under date of October 13, 1906, a contract was entered into with George G. Barker, of Wilmington, Del., for dredging to a depth of 23 feet through the worst of these shoals. To this work was applied about all the then available balance of approximately \$100,000, resulting in the formation of cuts 23 feet deep, 50 feet wide at bottom, and with an aggregate length of 46,888 feet from a point 600 feet north of light-house beacon 14 to a point 4,188 feet south of the same beacon, and from 2,840 feet north of light-house beacon 8-A to a point 1,056 feet south of light-house beacon 4. In this work 1,109,410 cubic yards of material, scow measurement, was removed from the channel.

A few sunken obstructions were also removed from the navigable channel during the year, adding much to the safety of its navigation.

Work under the project is about two-thirds completed.

On June 30, 1907, the maximum low-water draft that could be carried over the shoalest part of the improved channel was between 21 and 22 feet. The average range of tide is  $1\frac{1}{2}$  feet.

Mobile River is navigable for vessels of about 14 feet draft up as far as its head, about 45 miles above the city of Mobile.

Detailed information with reference to the work accomplished under the existing project is contained in the Annual Reports of the Chief of Engineers for 1901, page 1810, and 1904, page 1803. A reference to the report of the survey upon which the project is based is printed in the Annual Report of the Chief of Engineers for 1904, page 324.

The imports and exports, foreign and domestic, for 1905, aggregated 2,275,870 tons; value, \$57,793,100.12. Cotton, lumber, timber, breadstuffs, and hog products are the principal articles of export, and bananas and sisal grass the most important of the imports.

The effect of the project has been to give Mobile an average reduction of about 20 per cent on rail freight rates from Atlantic seaport cities and to afford direct water freight rates from Mobile to foreign ports.

## GENERAL IMPROVEMENT.

July 1, 1906, balance unexpended.....	\$102,362.55
Amount appropriated by river and harbor act approved March 2, 1907..	190,000.00
June 30, 1907, sale of Government property.....	75.00
June 30, 1907, refundment of overpayment.....	.37
	<hr/>
	292,437.92
June 30, 1907, amount expended during fiscal year, for maintenance of improvement .....	101,807.56
	<hr/>
July 1, 1907, balance unexpended.....	190,630.36
July 1, 1907, outstanding liabilities.....	1,630.00
	<hr/>
July 1, 1907, balance available.....	189,000.36
	<hr/>
Amount (estimated) required for completion of existing project.....	360,000.00
	<hr/>
{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907.....	
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897.	
	360,000.00

## REMOVING OBSTRUCTIONS.

July 1, 1906, balance unexpended.....	\$148.14
Amount appropriated by river and harbor act approved March 2, 1907..	10,000.00
	<hr/>
	10,148.14
June 30, 1907, amount expended during fiscal year, for maintenance of improvement .....	261.84
	<hr/>
July 1, 1907, balance unexpended.....	9,886.30
July 1, 1907, outstanding liabilities.....	80.00
	<hr/>
July 1, 1907, balance available.....	9,806.30

## CONSOLIDATED.

July 1, 1906, balance unexpended.....	\$102,510.69
Amount appropriated by river and harbor act approved March 2, 1907..	200,000.00
June 30, 1907, sales of Government property.....	75.00
June 30, 1907, refundment of overpayments.....	.37
	<hr/>
	302,586.06
June 30, 1907, amount expended during fiscal year, for maintenance of improvement .....	102,069.40
	<hr/>
July 1, 1907, balance unexpended.....	200,516.66
July 1, 1907, outstanding liabilities.....	1,710.00
	<hr/>
July 1, 1907, balance available.....	198,806.66
	<hr/>
Amount (estimated) required for completion of existing project.....	360,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907.....	
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897.	
	360,000.00

(See Appendix R 1.)

2. *Mobile bar, Alabama.*—Mobile bar is located in the Gulf of Mexico off the entrance to Mobile Bay. This bar had a depth of 23 feet at low water over ample width before any work of improvement was commenced upon it. This depth accommodated all the traffic

of the Mobile Bay ship channel, but was not sufficient to permit of the utilization of the deep anchorage in lower Mobile Bay beyond the southern limit of the dredged cut leading to the city of Mobile.

The original and existing project for this improvement was adopted in the river and harbor act of June 13, 1902, and provides for the formation of a channel 30 feet deep at low water and 300 feet wide across Mobile bar, at an estimated cost of \$91,250. This work of improvement formed a part of the Mobile Harbor project until March 3, 1905, when, by the river and harbor act of that date, it was made a separate project, and the limit of cost was increased to \$100,000.

Up to June 30, 1907, the sum of \$97,080.65 was expended on this improvement, of which \$25,000 was applied to the work of maintenance.

A channel from 27 to 29 feet deep and about 225 feet wide was dredged, but it subsequently shoaled, in some places to a depth of about 25½ feet. During the fiscal year 1906 the shoals were removed, and the channel was deepened to from 27 to 30 feet at mean low water over a width of from 250 to 275 feet.

The maximum draft that can be carried June 30, 1907, at mean low water over the shoalest part of the channel is about 28½ feet, and the average range of tide is 1.1 feet.

Available funds and future appropriations will be applied to maintaining the existing channel and deepening it to 30 feet throughout the projected width of 300 feet.

For commercial statistics, see Mobile Harbor report.

A reference to the report of the survey on which the existing project is based can be found in the Annual Report of the Chief of Engineers for 1904, page 324.

July 1, 1906 balance unexpended.....	\$3, 542. 80
Amount appropriated by river and harbor act approved March 2, 1907.....	50, 000. 00
	<hr/>
	53, 542. 80
June 30, 1907, amount expended during fiscal year, for works of improvement.....	623. 45

July 1, 1907, balance unexpended.....	52, 919. 35
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(See Appendix R 2.)

3. *Black Warrior, Warrior, and Tombigbee rivers, Alabama.*—(a) *Black Warrior River.*—This name refers to that portion of the Warrior River above Tuscaloosa. Originally this part of the river was practically closed to navigation on account of shoals at and above Tuscaloosa.

The original project for the improvement was adopted in 1887, the object being to obtain a channel for barges of 6 feet draft at low water all the year round between Tuscaloosa and Daniels Creek, 14½ miles above, by means of five locks and dams, at an estimated cost of \$741,670.

Locks 10, 11, and 12 (formerly known as 1, 2, and 3) were built by hired labor and have been completed and opened for traffic since November, 1895.

The river and harbor act of March 3, 1899, provided for the construction of Lock 4 (now Lock 13), at a cost not to exceed \$190,500. As it was subsequently found that the lock could not be completed for

the amount appropriated, the river and harbor act approved June 13, 1902, authorized the transfer of \$14,000 from the unexpended balance of the Warrior River appropriations for the completion of this lock. The same act extends the upper limit of the improvement to the junction of the Mulberry and Locust forks of the river, 46½ miles above Tuscaloosa, and provides for making a survey for the location of Locks 5 and 6 (now 14 and 15) next above Lock 4. Report of this survey is printed in the Annual Report of the Chief of Engineers for 1904, page 1840.

Work so far done has been the completion of Locks 10, 11, 12, and 13 (formerly known as 1, 2, 3, and 4), though additional lock houses are yet to be built and some grading done on lock grounds at Lock 13. Six feet of navigation can be carried 12 miles above Tuscaloosa to site of Lock 14. Beyond this there has been no improvement.

The river and harbor act of March 2, 1907, provides for the construction of Locks and Dams 14, 15, 16, and 17, at an estimated cost of \$1,409,000 to be provided under continuing-contract authorization and not yet appropriated, leaving Locks and Dams Nos. 18, 19, and 20, estimated to cost \$1,047,000, to be provided for. These estimates are exclusive of cost of surveys and sites, \$30,000, and additional land required at Lock No. 10, \$5,000. Fishways required at Dams Nos. 10, 11, 12, and 13 are estimated to cost \$4,000.

Plans and specifications have been completed for Locks 14 and 15, and proposals will be asked for their construction as soon as title to the necessary land for lock sites has been acquired. A party is now engaged in making location survey and foundation borings for Lock 16.

The total amount expended on this improvement to June 30, 1907, including the survey mentioned, was \$809,793.73, none of which was applied to maintenance.

The improvement of the Black Warrior River between Tuscaloosa and Daniels Creek is based upon the report of a Board of Engineers dated April 2, 1887, and published in the Annual Report of the Chief of Engineers for 1887, page 1302.

For commercial statistics, see report on operating and care of locks and dams on Black Warrior River, Alabama.

(b) *Warrior River*.—This name refers to that portion of the Warrior River below Tuscaloosa. Originally logs, snags, and overhanging trees rendered navigation impossible at low water and dangerous at boating stages. The minimum depth of channel was about 1 foot and the minimum width about 60 feet.

The original project for the improvement, adopted by the river and harbor act approved March 3, 1875, contemplated deepening the channel by jetty construction and the removal of snags and overhanging trees. The amount expended on this project from 1880 until the adoption of the present project was \$319,372. Prior to 1880 appropriations were made for the Warrior and Tombigbee rivers jointly, and the amount expended on the Warrior River up to that time is not known. An account of this work may be found in the Annual Report of the Chief of Engineers for 1897, page 1679.

The present project, adopted by the river and harbor act of March 3, 1899, is for the construction of six locks and dams (Nos. 4–9, inclusive, of the Black Warrior, Warrior, and Tombigbee system), with a total lift of 60 feet, and is to afford a channel for barges of 6 feet

draft at low water all the year round. The estimated cost of this work is \$1,928,466, exclusive of \$3,000 required for fishways in dams Nos. 7, 8, and 9. This work was commenced under continuing contract, but the completion of three of the locks by hired labor has been authorized.

The act last mentioned provided for the construction of three of these locks and dams at a cost not to exceed \$660,000. These three locks were completed at a cost of \$640,500, and are now being operated and cared for by the Government as Locks Nos. 7, 8, and 9, Black Warrior River. This work has resulted in opening up the river from Tuscaloosa to Lock 7, a distance of 79 miles, for navigation all the year round, though some dredging will be necessary to obtain a channel depth of 6 feet at the upper end of each pool. Towboats and barges of 4 feet draft have been operated on this section of the river during each low-water season since these locks were completed.

From the emergency appropriation of June 6, 1900, an allotment of \$3,691.24 was applied to maintaining the improvement of Warrior River by the removal of logs, trees, and slip-ins left in the channel after the floods of the spring of 1900.

The river and harbor act approved June 13, 1902, provided for the construction of Locks and Dams Nos. 1, 2, and 3 (new Nos. 4, 5, and 6), on this river, at a cost not to exceed \$874,000; also that \$10,000 of this amount might be applied to the work of maintenance of the improvement between Tuscaloosa and Demopolis.

Work on these locks was commenced under contract in May, 1903, and continued until December 31, 1904, when contractors abandoned the work. During February, 1905, the completion of these locks by hired labor was authorized. Since that time practically all of the necessary plant has been delivered and installed, the greater part of the materials purchased and delivered, and construction work is now in progress at all three locks with a large force. Up to the end of the fiscal year about 85 per cent of the work had been completed.

Changes in foundations, due to physical conditions at the sites, and increased cost of engineering expenses and contingencies, due to delays and final abandonment of work by contractors, and numerous rises in the river during the last two working seasons, will increase the cost of these locks above the amount originally authorized. The river and harbor act approved March 3, 1905, provided for the completion of these locks and the construction of Locks and Dams Nos. 1 and 2 in the Tombigbee River at a cost not to exceed \$881,466; also that not more than \$40,000 of this amount could be expended in the construction of a dredge and not more than \$30,000 for the construction of lock houses. This act appropriated \$100,000, and authorized the balance, \$543,466 of which was appropriated in the sundry civil act of June 30, 1906. Of the former appropriation, \$7,500 was allotted to the Warrior River work, and of the latter \$86,966. The sundry civil act of June 30, 1906, also appropriated the last \$60,000 authorized in the river and harbor act of June 13, 1902, for this work.

The river and harbor act of March 2, 1907, provides for the completion of the three Warrior River locks, on which work is now in progress, and it is believed that they will be finished this season.

The total amount expended on improvement of Warrior River under the existing project to June 30, 1907, was \$1,744,295.08, of which \$13,691.24 was applied to maintenance.

For commercial statistics, see report on "Operating and care of locks and dams on Black Warrior River." In addition to the commerce passing through these locks, about 8,000 tons of logs, 500 tons of lumber, 400 tons of coal, 1,200 tons of Portland cement, 200 tons of cotton, and 200 tons of general merchandise were shipped from points below Lock 7.

The report of the survey upon which the present project is based is printed in the Annual Report of the Chief of Engineers for 1890, page 1719. For revised estimate by the local engineer officer of the cost of building Locks and Dams Nos. 1, 2, and 3, see Annual Report of the Chief of Engineers for 1904, page 1845.

(c) *Tombigbee River from the mouth to Demopolis (construction of locks and dams).*—The original condition of the navigable channel of this section of the river was such as to permit of steamboat navigation during high stages of water only, lasting about six or eight months of the year. The minimum width of the channel was about 100 feet and the minimum depth about 2 feet.

For project, amount expended, etc., see report on maintenance of channel, Tombigbee River from the mouth to Demopolis.

The amount expended on work of lock and dam construction under the existing project to June 30, 1907, was \$365,011.40; for construction of dredge, \$36,554.30, and for construction of lock houses, \$7,732.51.

The river and harbor act of June 13, 1902, directed that a survey be made to determine the cost of completing Lock 1 and the location and cost of Locks 2 and 3, and this survey was made during 1902 and 1903. Report thereon is printed in the Annual Report of the Chief of Engineers for 1904, page 1842. During the fiscal year 1905 a part of the survey was gone over for the purpose of selecting more economical locations for Locks 2 and 3.

The river and harbor act approved March 3, 1905, made an appropriation of \$100,000, and provided for the further appropriation of \$781,466, to be applied to the completion of Locks and Dams Nos. 1, 2, and 3, Warrior and Tombigbee rivers, Alabama, and of Lock No. 1, Tombigbee River, and the construction of Lock No. 2, Tombigbee River. It was also provided that of these sums \$40,000 might be expended for the construction of a dredge and \$30,000 for the construction of lock houses necessary for the operation of locks and dams in the Black Warrior, Warrior, and Tombigbee rivers. The sundry civil act approved June 30, 1906, appropriated \$543,466 of the amount authorized by the river and harbor act of March 3, 1905, and the sundry civil act approved March 4, 1907, carried the balance of \$238,000. Provision was made in the river and harbor act of March 2, 1907, for construction of Lock and Dam No. 3 under continuing contract at a cost of \$483,000, of which \$433,000 is yet to be appropriated.

At the beginning of the fiscal year, Lock 1, at McGrews shoals, had been about two-thirds built, and plant and material were being assembled to complete the work. During the year plant was installed, upper lock gates placed, grubbing and clearing finished, three guard cribs built and filled with stone, cofferdam and abutment commenced, considerable stone received and some of it placed. Work about 75 per cent completed.

The construction of Locks and Dams Nos. 2 and 3 has not yet been commenced, but plans and specifications have been prepared and sub-

mitted for approval. It is hoped to commence work on these locks this season.

The hull of the dredge above provided for has been completed and launched, and the installation of necessary machinery commenced.

One lock house was built at Lock 2, and will be used as headquarters for the engineer force during construction of the lock and dam.

The construction of 60 miles of telephone line, connecting Locks 1 and 2 and Jackson, Ala., has been about 50 per cent completed.

For commerce in the calendar year 1906, see report on maintenance of channel in Tombigbee River from mouth to Demopolis.

The last two river and harbor acts have provided for the completion of all locks on the Tombigbee and Warrior rivers, and for carrying the work up to and including Lock 17 on Black Warrior River. The estimate for completion covers construction of permanent works only and does not include funds which will be required for operation of the dredge, about \$35,000 biennially.

It is therefore proposed to apply funds available for locks and dams and the amount estimated as a profitable expenditure in fiscal year ending June 30, 1909, to the completion of Locks and Dams No. 1, Tombigbee River at McGrews shoals, and Nos. 1, 2, and 3, Warrior River; the construction of locks and dams Nos. 2 and 3, Tombigbee River; the commencement of work on Locks 14 and 15, Black Warrior River, and making necessary surveys for sites of Locks 16, 17, 18, and 19 on this river.

The project for all year round 6-foot navigation from the Mulberry and Locust forks of Black Warrior River to Mobile, Ala., has not yet progressed sufficiently to have much, if any, effect on freight rates; but when completed it is expected to cause a great reduction in such rates from the mining section of Alabama to the Gulf of Mexico.

## LOCKS AND DAMS.

July 1, 1906, balance unexpended.....	\$624, 776. 50
Amount appropriated by river and harbor act approved March 2, 1907.....	350, 000. 00
Amount allotted from appropriation by sundry civil act approved March 4, 1907.....	233, 000. 00
Amount refunded from allotment for operating and care of locks on Black Warrior River.....	3, 000. 00
June 30, 1907, sales of Government property.....	25. 00
June 30, 1907, refundment of overpayments.....	. 25
	<hr/>
June 30, 1907, amount expended during fiscal year, for works of improvement.....	1, 210, 801. 75
	<hr/>
July 1, 1907, balance unexpended.....	432, 625. 44
July 1, 1907, outstanding liabilities.....	778, 176. 31
	<hr/>
July 1, 1907, balance available.....	67, 000. 00
	<hr/>
July 1, 1907, balance available.....	711, 176. 31
	<hr/>
July 1, 1907, amount covered by uncompleted contracts.....	12, 500. 00
Amount (estimated) required for completion of existing project..	2, 931, 000. 00
	<hr/>
{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907.....	700, 000. 00
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897.	



## DREDGE.

July 1, 1907, balance unexpended.....	\$37,982.57
June 30, 1907, amount expended during fiscal year, for works of improvement.....	34,536.87
July 1, 1907, balance unexpended.....	3,445.70
July 1, 1907, outstanding liabilities.....	690.00
July 1, 1907, balance available.....	2,755.70

## LOCK HOUSES.

July 1, 1906, balance unexpended.....	\$22,141.32
Amount allotted from appropriation by sundry civil act approved March 4, 1907.....	5,000.00
	27,141.32
June 30, 1907, amount expended during fiscal year, for works of improvement.....	4,873.83
July 1, 1907, balance unexpended.....	22,267.49

## CONSOLIDATED.

July 1, 1906, balance unexpended.....	\$684,900.39
Amount appropriated by river and harbor act approved March 2 1907.....	350,000.00
Amount appropriated by sundry civil act approved March 4, 1907.....	238,000.00
Amount refunded from allotment for operating and care of locks on Black Warrior River.....	3,000.00
June 30, 1907, sales of Government property.....	25.00
June 30, 1907, refundment of overpayments.....	.25
	1,275,925.64
June 30, 1907, amount expended during fiscal year, for works of improvement.....	472,036.14
July 1, 1907, balance unexpended.....	803,889.50
July 1, 1907, outstanding liabilities.....	67,690.00
July 1, 1907, balance available.....	736,199.50
July 1, 1907, amount covered by uncompleted contracts.....	12,500.00
Amount (estimated) required for completion of existing project...	2,931,000.00

Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907.....	700,000.00
Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

(d) *Tombigbee River from the mouth to Demopolis (maintenance of channel).*—The original condition of the channel of this portion of the river was such as to permit of steamboat navigation during high-water stages only, lasting about six or eight months of the year. The minimum width of the channel was about 100 feet and the minimum depth 2 feet.

The original project for the improvement of this stream, as adopted in 1871, contemplated the removal of snags and other obstructions in the channel of the river and the widening and deepening of the existing channel through various shoals, at an estimated cost of \$21,500. The project adopted in 1879 was to afford a channel of navigable width and 4 feet deep at ordinary low water from the mouth to Demopolis, a distance of 185 miles, by the removal of snags, logs, and overhanging trees, and the improvement of the worst bars by dredging.

The amount expended on the improvement of this section of Tombigbee River under previous projects can not be given, as joint appropriations for the Warrior and Tombigbee rivers were made from 1875 to 1879, while between 1880 and 1888 the lower division of the river, for which appropriations were made, extended from Vienna to the mouth.

The earlier projects for the improvement of this section of Tombigbee River were superseded by the project adopted in the river and harbor act of September 19, 1890. The project adopted at that time provided for securing a channel 6 feet deep at low water between the mouth and Demopolis by the construction of locks and dams and bank revetments, and by the removal of logs, snags, and other obstructions. The cost of this project was originally estimated at \$508,808.98, but in 1897, after \$330,000 had been appropriated for the work, the estimate was increased, the additional cost of completion being then placed at \$600,000.

By the river and harbor act of June 13, 1902, the formation of a 6-foot channel below Demopolis by constructing locks and dams was made a part of the project for securing 6-foot navigation in the Black Warrior, Warrior, and Tombigbee rivers, Alabama. Information in regard to work accomplished on the Tombigbee River under this project and the expenditures made in connection therewith will be found in the section of this report immediately preceding.

Under previous projects this section of the Tombigbee River has been repeatedly cleared of snags, dikes have been constructed, dredging has been done at the worst bars, and the channel made navigable for steamboats at low stages of the river. The existing project for maintenance of the improvement of the Tombigbee River from the mouth to Demopolis was adopted by the river and harbor act of June 13, 1902, and contemplates the maintenance of the existing channel by the removal of logs, snags, and other obstructions from the stream, and by the repair of dikes.

The amount expended on work under the existing project up to the close of the fiscal year ending June 30, 1907, was \$24,280.70, all of which was applied to maintenance. Under this project all work has been performed by United States plant and hired labor, and the channel of the stream has been maintained in a navigable condition.

During the past fiscal year some of the most dangerous obstructions in this section of river were removed by the U. S. snag boat *Black Warrior*. It is proposed to apply available funds and future appropriations to maintenance work—snagging, dredging, construction of jetties, and the construction of a self-propelling snag boat.

The Tombigbee River is navigable for steamboats as far up as Columbus, Miss., a distance of 341 miles above its mouth, and for rafts as far up as Walkers Bridge, Miss., a farther distance of 169 miles. This stream is nontidal, except in its lower reaches. Floods at Demopolis rise at times to a stage of 60 feet above low water.

Detailed accounts of this improvement are contained in the Annual Reports of the Chief of Engineers for 1896, page 1437; 1897, page 1685, and 1900, page 2202.

Commerce on this section of the river in the calendar year 1906 aggregated 414,932 tons, valued at \$6,700,392.

This project results in affording cheap water rates between Mobile and points along the lower Tombigbee River.

July 1, 1906, balance unexpended.....	\$14,349.92
Amount appropriated by river and harbor act approved March 2, 1907.....	16,000.00
	<hr/> 30,349.92
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	3,781.62
	<hr/> 26,568.30
July 1, 1907, balance unexpended.....	26,568.30

(e) *Tombigbee River from Demopolis, Ala., to Columbus, Miss.*—The original condition of this section of the river was such as to admit of navigation only during high-water stages. The channel was obstructed by shoals, logs, and overhanging trees, the minimum depth of water being 1 foot and the minimum width of channel 70 feet. The improvement of the Tombigbee River between Demopolis and Columbus was commenced under the project of 1871, which contemplated the improvement of this stream by the removal of snags and other obstructions in the river and the widening and deepening of existing channels through various bars. In 1879 this project was modified so as to provide for the formation of a channel of navigable width and 3 feet deep at low water from Demopolis to Columbus, this section forming a part of two different improvements.

The earlier appropriations being made for the Warrior and Tombigbee rivers jointly, the exact amount expended on the original project for this improvement can not be stated.

The present project for improvement of this section of Tombigbee River, adopted in 1890, provides for securing a channel 6 feet deep at low water from Demopolis to Columbus, a distance of 156 miles, by snagging, tree cutting, bank revetment, bar improvement, and the construction of locks and dams, at a cost originally estimated at \$779,400. In 1897 the construction of locks and dams was estimated to cost \$2,000,000. This project was adopted by the river and harbor act of September 19, 1890, but no provision has yet been made by Congress for commencing the work of lock and dam construction. The fall of the river from Columbus to Demopolis is about 108 feet.

The total amount expended on work under the existing project up to the close of the fiscal year ending June 30, 1907, was \$167,936.57, of which about \$67,479.68 was applied to maintenance. These expenditures have resulted in the formation of a clear channel within the limits of the project available for light-draft boats on a 2-foot rise above low water and in the partial maintenance of this improvement. Work has been prosecuted by means of United States plant and hired labor.

During the past fiscal year about 97 miles of this section of river were worked over with the snag boat *Vienna*, after which the *Vienna* was laid up for the high-water season. She was repaired while laid up, and has recently been towed to near the upper limit of the improvement, from which point she will work downstream.

It is proposed to apply available funds to the work of maintaining the improvement by the removal of snags, trees, and other obstructions brought into the channel by freshets. The maximum height of these freshets at Columbus is 40 feet.

The commerce on this section of the river for the calendar year 1906 amounted to about 9,775 tons, valued at \$471,999.

This project results in affording water rates from Mobile to points on the Tombigbee River above Demopolis for several months each year.

July 1, 1906, balance unexpended.....	\$7, 113. 08
Amount appropriated by river and harbor act approved March 2, 1907.....	12, 000. 00
	<hr/>
	19, 113. 08
June 30, 1907, amount expended during fiscal year, for maintenance improvement.....	5, 049. 65
	<hr/>
July 1, 1907, balance unexpended.....	14, 063. 43
July 1, 1907, outstanding liabilities.....	510. 00
	<hr/>
July 1, 1907, balance available.....	13, 553. 43

(f) *Tombigbee River from Columbus to Walkers Bridge, Miss.*—Prior to 1902 this improvement was divided into two sections, one from Columbus to Fulton, 144 miles, and the other from Fulton to Walkers Bridge, 25 miles, for which appropriations were made separately.

The original condition of the river was such that navigation was impossible except at high water, and difficult even at that stage, owing to the logs, snags, and overhanging trees which obstructed the channel. The minimum depth in the channel was about 1 foot, and the minimum width was 50 feet.

The project for the improvement of the river above Columbus was adopted in 1873, and provided for obtaining a good high-water channel by the removal of obstructions, at an estimated cost of \$35,000. This project was completed in 1882, at a cost of \$27,293.65, since which time operations have been directed toward maintaining the improvement. The first specific appropriation for the portion of the river between Fulton and Columbus was made in 1892, this money, together with subsequent appropriations, being applied to the maintenance of a high-water channel.

The project for improvement of the river from Fulton to Walkers Bridge was adopted in 1888, and provides for securing a high-water channel by the removal of logs, snags, and overhanging trees, at an estimated cost of \$11,000, and for the maintenance of the same at an annual cost of \$1,500. This project was adopted by the river and harbor act of August 11, 1888, and was completed in 1891, at a cost of \$6,517.19.

The total amount expended on these projects up to the close of the fiscal year ending June 30, 1907, was \$74,375.10, of which amount \$40,564.26 had been applied to maintenance. United States plant and hired labor have been employed on this work.

Between July 1 and December 5, 1903, and June 16 and September 10, 1905, the river was cleared out, resulting in the removal of obstructions from Aberdeen up to a point a short distance above Fulton, Miss.

As a result of the work done on this section of Tombigbee River it has been possible to bring large rafts of logs and timber down on a rise of a few feet above low water. But the freshets here range from 20 to 40 feet during the high-water season, and many obstructions are brought into the stream by these floods, rendering it necessary to remove these obstructions each season in order to keep the channel open. This part of the river is nontidal.

It is proposed to apply available funds to the work of maintaining a high-water channel within the limits of the improvement.

A reference to reports on surveys upon which a portion of this project is based is printed in the Annual Report of the Chief of Engineers for 1905, page 340.

The commerce on this section of the river during the calendar year ending December 31, 1906, amounted to 1,000 tons of heading bolts and general merchandise, valued at \$40,000.

Funds for work on this part of the river are allotted from the appropriation for Tombigbee River, Demopolis to Columbus.

This project has no effect on freight rates.

July 1, 1906, balance unexpended.....	\$291. 95
Amount appropriated by river and harbor act approved March 2, 1907.....	2, 000. 00

July 1, 1907, balance unexpended.....	2, 291. 95
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(See Appendix R 3.)

4. *Operating and care of locks and dams on Black Warrior River, Alabama.*—(a) *Lock 7.*—This lock is about 79 miles by river below Tuscaloosa. Contract work was completed and the lock turned over to the United States November 7, 1903. At that time its operation and care became a charge under the general law of July 5, 1884.

The lock was opened for traffic November 27, 1903, and has been used regularly since. During the past year four guide cribs have been built along upper approach to lock. Stone filling has been placed below dam to check erosion. Underbrush and piles of drift have been cleared off of reservation; river bank below abutment, which was badly eroded, has been graded to an approximate slope and protected with brush mattress and riprap. Flood deposit has been dredged from lock chamber and approaches. Lock-tender's house painted.

(b) *Lock 8.*—This lock is about 63 miles by river below Tuscaloosa. Contract work was completed and this lock turned over to the United States in December, 1902. On January 1, 1903, its operation and care became a charge under the general law of July 5, 1884.

On account of delay in erecting the gates, damage to timber floor by upthrust, and a large leak which developed under abutment, this lock was not opened for traffic until October 13, 1903. Since that time it has been used regularly, except twenty-six days during November, 1904, when it was closed to traffic for repairs to timber floor, and a few days during January, 1906, on account of large accumulations of drift in upper approach to lock.

During the past year material for new guide cribs was delivered and one crib completed along upper approach to lock. Underbrush and piles of drift have been cleared off of reservation and Bermuda grass planted on river banks near lock. Lock house has been painted.

(c) *Lock 9.*—This lock is about 46 miles by river below Tuscaloosa. Contract work was completed and the lock turned over to the United States in December, 1902. On January 1, 1903, its operation and care became a charge under the general law of July 5, 1884.

This lock was opened for traffic in October, 1902, and has been used regularly since. During the past year a number of trees, which caved from bank into river above lock, have been pulled out with derrick boat. Flood deposit has been dredged from lock chamber and approaches to lock and all timber for new guide cribs delivered.

(d) *Locks 10, 11, and 12.*—These locks and dams are near Tuscaloosa, Ala., and overcome the Tuscaloosa Falls with their combined lift of 29 feet. They were finished and opened to commerce in November, 1895, and on July 1, 1896, their operation and care became a charge under the general law of July 5, 1884.

In addition to their operation and care, flood deposit has been dredged from the lock chambers. Minor repairs were made to buildings, all lock houses and fences around lock grounds painted, and the necessary repairs to plant kept up at the Tuscaloosa shops. One of the gates at Lock 11, which had been badly damaged during high water in March, 1906, was taken down and rebuilt.

(e) *Lock 13.*—This lock is about 9 miles above Tuscaloosa. Contract work was completed and the lock turned over to the United States in May, 1905. On July 4, 1905, it was opened for traffic and its operation and care became a charge under the general law of July 5, 1884. Since that time two additional guide cribs have been built above the lock and the river bank below dam abutment thoroughly protected with riprap.

During the past year, in addition to operating and care of locks, the lock-tender's house has been painted and flood deposit removed from around lower gates.

The total expense during the year for operating, repairs, etc., for the seven locks was \$48,721.15. The commerce passing through the locks during the fiscal year ending June 30, 1906, amounted to 2,607 tons coal, 15,491 tons stone, 6,200 tons logs, 2,492 tons lumber, 206 tons cotton, 202 tons cotton seed, 480 tons fertilizer, and 270 tons of general merchandise. In addition to the commerce passing through the locks there is some coal traffic in the pool between Locks 12 and 13 and a considerable traffic in logs in the pool between Locks 7 and 8. No accurate record of this traffic is available.

(See Appendix R 4.)

5. *Pascagoula River, Mississippi.*—Before this improvement was commenced the channel through the bar at the mouth of the river had a least depth of 3 feet at low water, while inside the mouth for a distance of 10 miles upstream the river was navigable for vessels of 6½ feet draft. Appropriations for this work of improvement were made in 1827, 1828, and 1852, but there is no record of the work accomplished with those funds.

The first extended project for the improvement of this stream was adopted in 1880 and contemplated securing a channel 7 feet deep and 200 feet wide across the bar at the mouth of the river. This project also included some snagging work on the river above Moss Point, which is described in the report on the improvement of the Pascagoula, Leaf, and Chickasaw rivers, Mississippi. The project for a 7-foot channel was practically completed in 1884, the total amount expended in securing such a channel, including the appropriations made between 1827 and 1852, amounting to \$74,500.

In 1886 a new project was adopted, which provided for securing a channel 12 feet deep at low water, with a navigable width between Mississippi Sound and Moss Point. Under this project a depth of 9 feet across the entrance bar was first obtained, while subsequently a channel 12 feet deep and 80 feet wide was dredged from Moss Point to the mouth of the river, and a 12-foot channel across the bar at

the mouth was partially completed. These operations required the expenditure of \$95,000, including the expenditure of about \$8,000 applied to dredging work in Horn Island Pass in 1897, or a total of \$169,500 under both projects.

The present project for the improvement of Pascagoula River was adopted in the river and harbor act of March 3, 1899, and provided for the formation of a 12-foot channel from a point in Dog River 3 miles above its mouth down the Pascagoula River to the 12-foot contour in Mississippi Sound, 150 feet wide above and 300 feet wide below the railroad bridge at Scranton, Miss., at an estimated cost of \$317,600, including the formation of a 20-foot channel through certain shoal spots in the Horn Island anchorage.

Work under this project was in progress between September, 1899, and February, 1902, during which time an uninterrupted 12-foot channel was obtained within the limits of the project in Pascagoula River, while a 20-foot channel was formed through the shoal areas in Horn Island anchorage.

The river and harbor act of June 13, 1902, modified and extended the existing project so as to provide for a channel 17 feet deep instead of 12 feet from 3 miles above the mouth of Dog River to Mississippi Sound, at a total cost of \$1,050,222, exclusive of the Horn Island improvement, and authorized the expenditure of \$150,000 for the commencement of operations under the modified project.

The total amount expended on the existing project up to the close of the fiscal year ending June 30, 1907, was \$528,952.33, excluding the expenditure of about \$88,000 on the work performed at Horn Island. Of this amount \$40,000 was applied to maintenance. Work under the project is about 50 per cent completed. Dredging operations under the modified project were in progress from July 7, 1903, to June 16, 1904, during which time the channel was dredged to a depth of 15 feet for a width varying from 75 to 100 feet throughout its length, except one shoal spot at the upper end. Under date of June 16, 1905, two contracts were entered into for further work in the formation of the 17-foot channel within the limits of the project, the work being divided into two sections.

Up to the end of the past fiscal year a channel 42,402 feet long in section 1 and 17,600 feet long in section 2 was dredged to the projected depth of 17 feet, with a width of from 125 to 150 feet.

The contract for section 1 was completed May 2, 1907, a total of 804,776 cubic yards of material having been removed. The channel above the railroad bridge has been completed.

The contract for section 2 was completed June 15, 1907, a total of 663,386 cubic yards having been removed, including 73,713 cubic yards redredging of shoals formed since the dredge passed over the work about a year ago.

The available low-water draft is now about 17 feet. The average range of tide is  $1\frac{3}{4}$  feet.

The head of continuous navigation on Pascagoula River is at Cedar Creek, about 55 miles above the mouth, to which point a draft of 5 feet can be carried.

It is proposed to apply the available balance toward the completion of the project and its maintenance.

In order to determine the type of dredge suitable to the work, it is proposed to employ the U. S. dredge *Barnard* on this channel for two or three months, commencing about July 1, 1907.

A reference to the report of the survey of the Pascagoula River upon which the existing project is based is printed in the Annual Report of the Chief of Engineers for 1904, page 334. An account of this improvement is contained in the Annual Reports for 1902, page 2211, and 1904, page 1828.

The commerce of the river for the calendar year 1906 amounted to 730,671 tons, principally logs, lumber, and naval stores, valued at \$6,265,964.

This project results in effecting a reduction in rail freight rates between Scranton, Miss., and seaboard cities of the Atlantic coast, and also in affording direct water freight rates on lumber from Moss Point and Scranton to foreign ports.

July 1, 1906, balance unexpended.....	\$117, 622. 08
Amount appropriated by river and harbor act approved March 2, 1907 .....	200, 000. 00
June 30, 1907, refundment of overpayments.....	4. 34
	<hr/>
	317, 626. 42
June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$76, 974. 41
For maintenance of improvement.....	40, 000. 00
Transferred to construction of dredge.....	50, 000. 00
	<hr/>
	166, 974. 41
July 1, 1907, balance unexpended.....	150, 652. 01
July 1, 1907, outstanding liabilities.....	1, 300. 00
	<hr/>
July 1, 1907, balance available.....	149, 352. 01
	<hr/>
Amount (estimated) required for completion of existing project---	360, 622. 00

(See Appendix R 5.)

6. *Pascagoula, Leaf, and Chickasahay rivers, Mississippi.*—(a) *Pascagoula River (above the mouth of Dog River).*—Before this improvement was commenced navigation was impossible on this section of Pascagoula River, except during periods of high water. The minimum width of the channel was 60 feet and the minimum depth was 1 foot, the stream being very much obstructed by snags and logs. The first project for this improvement, which was adopted in 1880, in addition to providing for dredging work at the mouth of the stream, described in the report on the improvement of Pascagoula River, Mississippi, contemplated the improvement of the river by the removal of snags and overhanging trees. Under this project the river was cleared of obstructions between 1882 and 1884, at a cost of \$15,000. In 1886 the existing project for this improvement was adopted. This project provides for the maintenance of the channel above the mouth of the river by removal of obstructions from the stream from time to time. This project was modified in 1899, the extent of the improvement being limited at that time to the section of the river above Dog River, about 100 miles. The total amount expended on the existing project to June 30, 1907, was \$23,018.14, all of which was applied to maintenance.

The river and harbor act of March 3, 1905, appropriated \$12,000 for improving Pascagoula, Leaf, and Chickasahay rivers, Mississippi,



of which amount \$6,750 was allotted to the Pascagoula River. These funds and future appropriations will be applied to maintaining the channel, including part payment for self-propelling snag boat.

A snagging party was organized, supplies were purchased, and the work of removing sunken obstructions from this part of Pascagoula River was commenced June 7, 1906, continued through June and July, and again in November and December, 1906, practically the entire river being worked over twice during the season. However, owing to the lack of suitable plant on this improvement, many of the worst obstructions could not be removed.

On June 30, 1907, the Pascagoula River was navigable at low water for boats of 5 feet draft as far up as Cedar Creek, 55 miles, while above this point to the head of the river light-draft navigation and rafting were possible on a slight rise above low water.

The Pascagoula River is nontidal except in its lower reaches.

The report of the examination upon which this improvement was originally based is printed in the Annual Report of the Chief of Engineers for 1879, page 835.

The commerce originating on Pascagoula River above the mouth of Dog River during the calendar year 1906 amounted to 260,100 tons, principally logs, naval stores, and general merchandise, valued at \$3,323,600. In addition to this the combined commerce of Chickasaw and Leaf rivers passed over this stream.

This project has no effect on freight rates.

July 1, 1906, balance unexpended.....	\$5,437.90
Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	6,000.00
	<hr/> 11,437.90
June 30, 1907 amount expended during fiscal year, for maintenance of improvement.....	1,706.04
	<hr/> 9,731.86

(b) *Leaf River*.—Originally it was impracticable to navigate this river on account of snags, logs, and overhanging trees obstructing the channel. The minimum width of the stream was 100 feet and the minimum depth was  $2\frac{1}{2}$  feet. The original project for this improvement was adopted in 1890, its purpose being to afford a channel for high-water navigation from Bowie Creek to the mouth of the river, a distance of 75 miles, by the removal of obstructions and overhanging trees. This project was completed in 1897 at a cost of \$11,019.04, since which time expenditures have been in the direction of maintaining the improvement.

During August, September, and October, 1906, about 63 miles of the river was worked over upstream and 53 miles of this distance reworked downstream, clearing the channel of obstructions as well as possible with the plant available for such work.

With available funds and future appropriations similar maintenance work will be continued.

The total amount expended on this improvement up to June 30, 1907, was \$21,958.51, of which \$10,939.47 was applied to maintenance.

On June 30, 1907, the river was available for rafting on a fair rise above low water, being used to a very limited extent for any other form of navigation.

For references to the report upon which this project is based and to descriptions of this improvement, see the Annual Report of the Chief of Engineers for 1904, page 337.

The commerce of the Leaf River during the calendar year 1906 amounted to 177,800 tons, principally logs and timber, valued at \$1,223,250.

This project has no effect on freight rates.

July 1, 1906, balance unexpended-----	\$2,813.51
Amount allotted from appropriation by river and harbor act approved	
March 2, 1907-----	2,500.00
	<hr/>
	5,313.51
June 30, 1907, amount expended during fiscal year, for maintenance of	
improvement-----	1,772.02
	<hr/>
July 1, 1907, balance unexpended-----	3,541.49

(c) *Chickasahay River*.—The original condition of this river was such that it was navigable for small rafts only during high water, and even navigation of this character was troublesome and dangerous. The minimum width of the channel was 50 feet and the minimum depth 6 inches, the river being badly obstructed by logs and snags.

The original project for the improvement was adopted by the river and harbor act of September 19, 1890, and provided for obtaining a high-water channel from the mouth of the river up to Shubuta, Miss., a distance of 130 miles, by the removal of obstructions from the channel and overhanging trees from the banks. The river and harbor act of June 3, 1896, modified this project by limiting the improvement to that part of the river between the mouth and Bucatunna, Miss., about 75 miles. The project further provided for the maintenance of the improved channel. The project, as modified, was completed in the latter part of 1896, at a cost of \$12,399.73.

During the fiscal year ending June 30, 1904, the entire improvement was worked over, this work being completed October 19, 1903, leaving the river in very fair condition for rafting and flatboats on a rise of 3 or 4 feet above low water. No work has been done since, and many obstructions have been brought into the stream by freshets. The removal of these obstructions with available funds has just been commenced.

The total amount expended on the improvement up to June 30, 1907, was \$21,750, of which \$9,350.27 had been applied to maintenance.

The existing project was adopted in the river and harbor act of March 3, 1905, and provides for maintaining the channel in Chickasahay River from the mouth to Bucatunna, Miss., by the removal of logs, snags, and other obstructions from the waterway, in order to keep the river in navigable condition for rafting at high-water stages, at an annual cost of \$2,500. A reference to the report of the examination upon which this project is based is printed in the Annual Report of the Chief of Engineers for 1905, page 346.

This stream is nontidal, and its condition on June 30, 1907, was such that it could be used by flatboats and rafts on a rise of 6 or 8 feet up as far as Shubuta, Miss., though considerably obstructed.

The commerce of this river during 1906 amounted to 168,325 tons of logs and timber, valued at \$1,197,000.

July 1, 1906, balance unexpended-----	\$2,000. 00
Amount allotted from appropriation by river and harbor act approved March 2, 1907-----	1,500. 00
July 1, 1907, balance unexpended-----	3,500. 00
July 1, 1907, outstanding liabilities-----	190. 00
July 1, 1907, balance available-----	3,310. 00

## CONSOLIDATED.

July 1, 1906, balance unexpended-----	\$10,251. 41
Amount appropriated by river and harbor act approved March 2, 1907-----	10,000. 00
	20,251. 41
June 30, 1907, amount expended during fiscal year, for maintenance of improvement-----	3,478. 06
July 1, 1907, balance unexpended-----	16,773. 35
July 1, 1907, outstanding liabilities-----	190. 00
July 1, 1907, balance available-----	16,583. 35

(See Appendix R 6.)

7. *Horn Island Pass, Mississippi.*—The channel through the bar had before improvement a depth which increased through natural causes from 14 or 15 feet in 1853 to about 18 feet in 1886, and has been available at low water since the latter date for vessels up to a draft of slightly less than 18 feet.

Under the appropriations for improving Pascagoula River, Mississippi, carried by the river and harbor acts of August 18, 1894, and June 3, 1896, provision was made for the removal of the bar in Horn Island Pass, and in conformity with this provision a channel with a least depth of 20.5 feet (19.5 feet referred to the existing datum), and with a width of 200 feet, was dredged through the Horn Island bar. The total cost of this work was \$7,682.40, but the benefit of the improvement was soon lost through shoaling.

Under the appropriations for Pascagoula River and Horn Island Harbor carried by the river and harbor act of March 3, 1899, and the sundry civil act of June 6, 1900, an amount estimated at about \$88,000 was applied to dredging a 20-foot (19 feet present datum) channel at certain shoal areas in the Horn Island anchorage basin, the work being in progress between 1899 and 1901.

The existing project for the improvement of Horn Island Pass provides for the formation of a channel 21 feet deep at low water, 300 feet wide through the outer bar, and 200 feet wide elsewhere in the pass, at an estimated cost of \$40,480, and \$9,000 annually to preserve the improvement. The project was adopted by the river and harbor act of March 3, 1905, which carried an appropriation of \$40,480 for the work, subject to the condition "that a contract or contracts can be made at a sum not to exceed the unit price of eleven cents per cubic yard, or such work can be performed by a Government dredge."

The proposed dredging work was advertised under date of May 16, 1905, but no bids for its execution were received in response to this advertisement. The U. S. dredge *Charleston* has been employed on this work since August, 1906, and has dredged 353,230 cubic yards of material, at a cost to date of \$29,697.67, in addition to outstanding liabilities of about \$2,800.

Available funds will be applied to completion of the 21-foot channel and to its maintenance.

The report upon which this project is based is printed in the Annual Report of the Chief of Engineers for 1904, page 1863.

The available low-water depth through the pass is about 21 feet, and the average range of tide is about 1.1 feet.

Commerce using the Horn Island Pass channel during the calendar year 1906 amounted to 185,044 tons of lumber and timber, valued at \$1,444,840.

This improvement has as yet little or no effect on freight rates.

July 1, 1906, balance unexpended.....	\$40,374.54
Amount appropriated by river and harbor act approved March 2, 1907.....	9,000.00
	<hr/>
	49,374.54
June 30, 1907, amount expended during fiscal year, for works of improvement.....	29,592.21
	<hr/>
July 1, 1907, balance unexpended.....	19,782.33
July 1, 1907, outstanding liabilities.....	2,800.00
	<hr/>
July 1, 1907, balance available.....	16,982.33

(See Appendix R 7.)

8. *Harbor at Biloxi, Miss.*—This channel originally had a minimum depth of 4 feet. The original project for its improvement was adopted in 1882 and contemplated the formation of a channel through Deer Island flats to connect Biloxi Bay with the Back Bay of Biloxi, at an estimated cost of \$35,000. The channel thus proposed was to have a depth of 8 feet at low water, with a width sufficient for navigation.

In 1884 this project was changed so as to provide for deepening the channel from Mississippi Sound to the wharves at Biloxi from the existing depth of 4 or 4½ feet to 8 feet over a width of 150 feet, the estimated cost of this work being \$55,000. The work of dredging was commenced in September, 1887, and the project was finally completed in August, 1893, at a cost of \$44,382.27. Between December 26, 1903, and January 28, 1904, the channel was redredged to a depth of 8 feet for a width of from 70 to 100 feet throughout its length, completing about one-half the work necessary to fully restore the channel.

Under contract dated August 4, 1906, with the Home Dredging Company, of Mobile, Ala., 27,139.3 cubic yards of material was dredged from this channel, restoring the depth of 8 feet over a width of 50 feet, for a distance of 4,134 feet. Measurement was in place, and the rate paid was 25½ cents per cubic yard.

Available funds and future appropriations will be applied to maintaining a channel 8 feet deep and as great a width as possible, not exceeding 150 feet.

The commerce of this harbor for the calendar year 1906, consisting principally of lumber, turpentine, rosin, fish, and oysters, and general merchandise, amounted to about 77,414 tons, valued at \$2,483,500.

The total amount expended on this improvement up to June 30, 1907, was \$61,685.74, of which \$17,303.47 was applied to work of maintenance.

The maximum low-water draft that can be carried through the channel is about  $7\frac{1}{2}$  feet and the range of tide is about  $1\frac{1}{2}$  feet.

A reference to the report upon which the present project for this work of improvement is based is printed in the Annual Report of the Chief of Engineers for 1904, page 337.

The project has little or no effect on freight rates.

July 1, 1906, balance unexpended-----	\$8,845.50
Amount appropriated by river and harbor act approved March 2, 1907--	9,000.00
	<hr/> 17,845.50
June 30, 1907, amount expended during fiscal year, for maintenance of improvement-----	7,148.97
July 1, 1907, balance unexpended-----	10,696.53

(See Appendix R 8.)

9. *Channel from Gulfport to Ship Island Harbor, Mississippi.*—Originally no channel existed between Ship Island Harbor and Gulfport, Miss. The depths on the site of the channel ranged from 19 to  $8\frac{1}{2}$  feet, and over the site of the anchorage basin they varied from  $8\frac{1}{2}$  to  $2\frac{1}{2}$  feet.

The existing project was adopted by the river and harbor act of March 3, 1899, which authorized the Secretary of War to enter into contract for dredging a channel 300 feet wide and 19 feet deep at mean low water from the anchorage basin at Ship Island Harbor, on the Gulf of Mexico, to Gulfport, Miss., and to construct at the end of this channel next to the shore an anchorage basin of similar depth and not less than 2,640 feet by 1,320 feet in area. This act also authorized the Secretary of War to contract for the maintenance of this channel and anchorage basin for a term of five years after their completion for the sum of \$10,000 annually.

Contract was entered into in 1901 for dredging the channel and anchorage basin, the work to be completed within two years from April 21, 1901, for \$150,000, and for the maintenance of the channel and basin for a term of five years after completion for the sum of \$10,000 per annum.

Work was commenced on April 16, 1901, and has been in progress almost continuously since that date.

By joint resolution of Congress approved June 14, 1906, it was provided that the channel and basin should be accepted as dredged, and that \$150,000 should be paid the contractor for the work, the channel and basin having been dredged to the approximate depth and width required in the contract. The payment has been made. The period of maintenance commenced June 14, 1906.

The river and harbor act approved March 2, 1907, appropriated \$100,000 for continuing the improvement and maintenance of the anchorage basin at Gulfport and channel therefrom to the anchorage or roadstead at Ship Island, also Ship Island Pass between Ship and Cat islands, Mississippi, and authorized the Secretary of War to annul that portion of the contract entered into February 20, 1901, with Spencer S. Bullis, relating to the maintenance of a channel and anchorage basin between Ship Island and Gulfport. The annulment of this contract was effected by a supplemental agreement approved by the Secretary of War June 11, 1907.

The maximum low-water draft available in the channel and basin at the end of the fiscal year was about 21 feet. The range of tide at this locality is about  $1\frac{3}{4}$  feet. Vessels with a draft of 23 feet have lately passed through the channel.

Since the commencement of operations at Gulfport, allotments amounting to \$24,199.85 have been made from the permanent indefinite appropriation carried by section 4 of the river and harbor act of July 5, 1884, for the purpose of inspecting, superintending, and surveying this work of improvement. Up to June 30, 1907, the expenditures for this purpose amounted to \$22,048.09.

It is proposed to apply available funds to maintenance of the channel and anchorage basin.

A reference to the report upon which the present project is based can be found in the Annual Report of the Chief of Engineers for 1904, page 338.

The commerce at Gulfport Harbor during the calendar year 1906 amounted to 743,992 tons, principally lumber and timber, valued at \$9,374,865.

This project results in effecting a reduction in rail freight rates between Gulfport and seaboard cities of the Atlantic coast and in affording water freight rates from Gulfport to foreign ports.

July 1, 1906, balance unexpended.....	\$14,994.19
June 30, 1907, amount allotted during fiscal year.....	3,005.81
Amount appropriated by river and harbor act approved March 2, 1907.....	100,000.00
Amount appropriated by sundry civil act approved March 4, 1907....	10,000.00
	<hr/> 128,000.00
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	\$5,848.24
Transferred to construction of dredge.....	25,000.00
	<hr/> 30,848.24
July 1, 1907, balance unexpended.....	97,151.76
July 1, 1907, outstanding liabilities.....	400.00
	<hr/> 96,751.76

(See Appendix R 9.)

10. *Wolf and Jordan rivers, Mississippi.*—The least depth on the bar at the mouth of Wolf River is something under 3 feet, and on the bar at the mouth of the Jordan River it is not quite 4 feet.

The present and only project was adopted by the river and harbor act of March 2, 1907, and provides for the formation of a channel 7 feet deep and 100 feet wide at bottom, with side slopes of 1 on 6, across the bar at the mouth of each of the streams named, from the 7-foot curve of depth in the river to the 6-foot contour in Bay St. Louis, at a cost of \$30,000 for completing the work and \$5,000 per annum thereafter for maintenance. After reaching the 6-foot contour in the bay, the material becomes so soft that a draft of 7 feet can easily be carried through it. The act above mentioned also appropriated \$30,000 for dredging the channels, but no work has yet been done nor expenditures made.

The report of the examination and survey upon which the project is based is printed in House Document No. 917, Fifty-ninth Congress, first session. For previous reports of examinations reference is made to the Annual Report of the Chief of Engineers for 1893, pages 1787 and 1789.

The average range of tide is about 1½ feet.

The commerce on these rivers during the calendar year 1906 amounted to 53,865 tons of lumber, rosin, turpentine, and general merchandise, valued at \$946,860.

Amount appropriated by river and harbor act approved March 2, 1907. \$30,000.00  
 July 1, 1907, balance unexpended..... 30,000.00

(See Appendix R 10.)

11. *Pearl River below Rockport, Miss.*—The limits of this improvement originally extended from the mouth of the river to Jackson, a distance of 313 miles. By act of Congress of April 21, 1900, the construction of a fixed highway bridge across Pearl River at Rockport was legalized. This point thereby became the head of navigation for boats of any considerable size and the upper limit of the project. However, the bridge at Rockport is reported to have been washed away in February, 1906. The distance from Jackson to Rockport is 67 miles.

Prior to improvement the condition of the river was such that it was not navigable except during high-water stages, and even then navigation was difficult and dangerous.

The original project for this improvement was adopted in 1880, and provided for a channel of navigable width and 5 feet deep at low water, by the removal of snags and sunken trees from the river bed and overhanging trees from the banks, at an estimated cost of \$95,940. This project having been found to be impracticable, it was modified in 1885 so as to provide for a 2-foot channel at low water throughout this section of the river, at an estimated cost of \$145,940.

With past appropriations the river has been improved until it became navigable for light-draft boats on a slight rise up as far as Monticello, about 211 miles above the mouth. Above Monticello the river has never been navigable except on a rise of 7 feet or more. Appropriations since 1899 have been applied to the maintenance of the lower 100 miles of the river.

During the past fiscal year 86 miles of the river were worked over with the snag boat *Pearl*, after which this boat was laid up at Scranton for the winter. She has been extensively repaired and will resume work in the early part of the coming year. All this work has been for the purpose of maintenance.

The total amount expended on this improvement up to June 30, 1907, was \$171,229.07, of which about \$66,104.07 was applied to maintenance.

Recent appropriations have been sufficient only to maintain the channel in the lower 100 miles of the river, and this part is available for light-draft navigation on a fair rise. The upper portions of the stream not recently worked over are not safe for navigation on less than a 7 or 8 foot rise.

The 9-foot channel dredged at the mouth in 1900 has shoaled to 7½ feet, and should be redredged. It is proposed to apply part of the available funds to this work.

Available funds and future appropriations will be applied to prosecution of the improvement and to maintenance work where it is considered most needed for the commerce using this stream.

This river is nontidal except in its lower reaches.

The report upon which the project was originally based can be found in the Annual Report of the Chief of Engineers for 1879, page 879. Extended information may be found in the Annual Report of the Chief of Engineers for 1896, page 1454.

The commerce of the upper section of this part of Pearl River during the calendar year 1906 was 63,420 tons of naval stores, general merchandise, and timber, valued at \$990,390.

The project now has but little, if any, effect on freight rates, but if completed it is believed would cause a material reduction in these charges.

July 1, 1906, balance unexpended-----	\$4, 494. 17
Amount appropriated by river and harbor act approved March 2, 1907..	30, 000. 00
	<hr/> 34, 494. 17
June 30, 1907, amount expended during fiscal year, for maintenance of improvement -----	5, 311. 85
July 1, 1907, balance unexpended-----	29, 182. 32
July 1, 1907, outstanding liabilities-----	80. 00
	<hr/> 29, 102. 32
July 1, 1907, balance available-----	29, 102. 32
Amount (estimated) required for completion of existing project-----	<sup>a</sup> 80, 000. 00
(See Appendix R 11.)	

12. *Pearl River between Edinburg and Jackson, Miss.*—The original condition of this section of Pearl River was such that navigation was impossible, except during high water, and even at high stages it was difficult and dangerous. The minimum width and depth of the channel were 40 feet and 1 foot, respectively, between Carthage and Jackson, while above Carthage the channel had a minimum width of 30 feet and a minimum depth of 3 inches. This improvement was formerly divided into two sections, for which appropriations were made separately. The original project for the section from Jackson up to Carthage, 101 miles, as adopted in 1879, contemplated obtaining a clear channel of navigable width and 5 feet depth at low water, at an estimated cost of \$21,000. In 1886 this project was modified so as to provide for a channel 2 feet deep, this depth being considered sufficient for the needs of navigation, and at the same time the estimate of cost was increased to \$50,000. Work under this project was completed in 1893, at a total cost of \$26,014.98, since which time funds have been applied to maintenance.

The original project for the part of the river from Carthage up to Edinburg, a distance of 25 miles, was adopted in 1884 and provided for the formation of a high-water channel for use during six or eight months of the year, at an estimated cost of \$13,464, and for the maintenance of same at an annual cost of \$500. The work of improvement under this project was completed in 1890, at a cost of \$5,857.08, subsequent appropriations being applied to the work of maintenance.

<sup>a</sup>Assuming that revised estimate printed in House Document No. 183, Fifty-ninth Congress, second session, for completing this project has been adopted and that \$10,000 of amount appropriated in river and harbor act approved March 2, 1907, will be applied to maintenance dredging at mouth of East Pearl River.



The river and harbor act approved June 13, 1902, made one appropriation for this section, since which it has been considered as a single improvement and appropriations made accordingly.

Snagging operations were resumed on this section on June 27, 1906, at Edinburg and suspended December 23, 1906, on account of high water, 70 miles of river being worked over. This work will be continued with available funds.

Up to June 30, 1907, the total amount expended on this improvement was \$61,565.29, of which about \$29,693.23 had been applied to maintenance.

The report of the survey of Pearl River from Carthage to Jackson, upon which the present project was based, is published in the Annual Report of the Chief of Engineers for 1879, page 880, and the report of the survey of the river between Edinburg and Carthage, upon which the present project was based, is printed in the Annual Report of the Chief of Engineers for 1884, page 1287.

During the calendar year 1906 the commerce using this part of Pearl River amounted to 425 tons, valued at \$27,255, being principally hard wood, cotton, and general merchandise.

July 1, 1906, balance unexpended	\$3, 957. 90
Amount appropriated by river and harbor act approved March 2, 1907	3, 500. 00
	<hr/> 7, 457. 90
June 30, 1907, amount expended during fiscal year, for maintenance of improvement	2, 723. 19
	<hr/> 4, 734. 71
July 1, 1907, balance unexpended	4, 734. 71
July 1, 1907, outstanding liabilities	150. 00
	<hr/> 4, 584. 71

(See Appendix R. 12.)

*13. Dredge for harbors on coast of Mississippi.*—The river and harbor act of March 2, 1907, authorized the Secretary of War, in his discretion, to construct a dredge for use in said harbors and the channels adjacent thereto, at a cost not exceeding \$200,000, of which amount, in case said dredge is constructed, \$25,000 shall be taken from the appropriation therein for Gulfport Harbor and \$50,000 from the appropriation for Pascagoula River. The act is construed as authorizing the expenditure under contract of \$125,000 additional yet to be appropriated.

There were no expenditures to June 30, 1907, and before definite steps toward construction of the dredge are taken it is proposed to experiment with the U. S. dredge *Barnard* to determine the type of vessel most suitable to the work. Should construction be ordered, the sum of \$125,000 could be profitably expended on the work during the fiscal year 1909, but this amount has not been included in the annual estimates pending definite action in the matter.

Amount allotted from appropriations by river and harbor act approved March 2, 1907	\$75, 000. 00
July 1, 1907, balance unexpended	75, 000. 00
Amount (estimated) required for completion of existing project	125, 000. 00

*14. Removing sunken vessels or craft obstructing or endangering navigation.*—On May 25, 1906, an allotment of \$3,800 was made from the indefinite wreck appropriation for the purpose of removing an old sunken dry dock from Mobile River at the foot of Selma street,

Mobile, Ala. No expenditures have yet been made from this allotment, but under date of October 8, 1906, a contract was entered into with Robert Middleton, of Mobile, Ala., for the complete removal of the wreck for \$3,700. This contract was to have been completed by the middle of January, 1907, but time of completion was waived. Preparations are now being made by Mr. Middleton to complete his contract.

A former allotment of \$3,000 was made for the removal of this dock in 1893, but funds became exhausted before a great part of the work had been accomplished.

(See Appendix R 13.)

EXAMINATIONS AND SURVEY MADE IN COMPLIANCE WITH THE RIVER AND HARBOR ACT OF MARCH 3, 1905.

Reports on preliminary examinations and survey required by the river and harbor act approved March 3, 1905, of the following localities within this district were duly submitted by the district officer. They were reviewed by the Board of Engineers for Rivers and Harbors pursuant to law and were transmitted to Congress and printed in documents as indicated:

1. *Preliminary examination of Pearl River, Mississippi, from Edinburg to Lake Burnside.*—Report dated June 12, 1906, is printed in House Document No. 179, Fifty-ninth Congress, second session. This improvement is not deemed worthy of being undertaken by the General Government.

2. *Preliminary examination of Pearl River from the mouth to Rockport, Miss.*—Report dated June 28, 1906, is printed in House Document No. 183, Fifty-ninth Congress, second session. A revised estimate for completion of the existing project at a cost of \$100,000 within a period of five years and \$5,000 annually for maintenance is submitted.

3. *Preliminary examination of Tombigbee River from Demopolis, Ala., to Columbus, Miss., with a view to obtaining a continuous channel 4 feet deep.*—Report dated December 9, 1905, is printed in House Document No. 334, Fifty-ninth Congress, second session. The locality is not considered worthy of improvement by the United States in the manner proposed.

4. *Preliminary examination of the anchorage basin at Gulfport, Miss., and channel therefrom to the anchorage or roadstead at Ship Island, with a view to obtaining a sufficient depth and width; also, Ship Island Pass, between Ship and Cat islands, and survey of Ship Island Pass, Mississippi.*—Reports dated October 16, 1905, and June 27, 1906, are printed in House Document No. 184, Fifty-ninth Congress, second session. It is not deemed advisable for the United States to undertake this improvement.

IMPROVEMENT OF THE PASSES OF THE MISSISSIPPI RIVER, AND OF BAYOU LAFOURCHE, BAYOU PLAQUEMINE, GRAND RIVER, PIGEON BAYOUS, AND BAYOU TECHE, LOUISIANA.

This district was in the charge of Lieut. Col. Clinton B. Sears, Corps of Engineers, to July 16, 1906, and of Col. E. H. Ruffner, Corps of Engineers, since that date.

1. *Closing crevasse in Pass a Loutre, Mississippi River.*—Pass a Loutre is one of the three outlets of the Mississippi River. The crevasse forms an outlet from Pass a Loutre into an arm of the Gulf, known as Garden Island Bay, and was caused by the wearing away of the south bank of that pass at a locality  $1\frac{3}{4}$  miles below Head of Passes.

The ditch where the crevasse first broke was 3 feet wide in 1872, and increased from year to year. On November 18, 1896, the crevasse was 2,230 feet wide, and on February 26, 1897, Congress appropriated \$250,000 for the closure.

The project approved July 10, 1897, provided for building a dam 6,650 feet long in two sections, 1,900 and 4,750 feet long, respectively, forming an angle of  $112^\circ$ , at a distance of 3,000 feet below the mouth of the crevasse, the dam to be constructed of Wakefield sheet piling, backed with a double row of piles securely braced and bolted to stringers and the sheet piling, using a third row of brace piles where the depth of water exceeded 20 feet.

Under this project a contract for the work was approved December 10, 1897. Work was carried on from December 14, 1897, to January 27, 1898, and from August 5, 1898, to November 13, 1898. On the last-named date the work was considered completed and was accepted. At that time it seemed that the closure would prove a permanent success, notwithstanding the high stage of the river. A severe storm arose that night, and on November 14 the dam gave way in two localities and 170 feet of it washed out. Portions of the ends of the dam have washed away at intervals since then, and on June 30, 1907, the width of the break was 1,029.5 feet.

On February 17, 1898, Congress allotted \$10,000 from this appropriation for the expenses of a survey and report, by a Board of Engineer officers, upon the Southwest Pass.

The amount expended from this appropriation up to June 30, 1907, was \$228,995.08, of which \$6,727.36 was for the survey of Southwest Pass, and \$1,000, reserved March 6, 1902, for expenses of the Office of the Chief of Engineers.

No work toward closing the crevasse was attempted during the past year, the amount available being insufficient for the purpose.

Specifications for constructing sill across "Cubits Gap" and "The Jump," and placing additional mattresses on and building up the sill across the head of Pass a Loutre, Mississippi River, were approved by the Chief of Engineers May 17, 1907. The Secretary of War authorized, May 25, 1907, the use of the balance remaining from the appropriation of February 26, 1897, for "Closing Crevasse in Pass a Loutre, Mississippi River," \$21,029.92, toward the construction of the sill contemplated by the above-named specifications, the balance of the expenses of the work to be paid from the appropriation for Improving Southwest Pass, Mississippi River. Bids will be opened for this work July 6, 1907.

July 1, 1906, balance unexpended.....	\$21,029.92
July 1, 1907, balance unexpended.....	21,029.92

(See Appendix S 1.)

2. *Southwest Pass, Mississippi River.*—On February 17, 1898, Congress allotted \$10,000 from the appropriation for closing crevasse

in Pass a Loutre, Mississippi River, for the purposes of a survey and report, by a Board of Engineer officers, upon the practicability of securing a channel of adequate width and 35 feet depth at mean low water of the Gulf of Mexico throughout Southwest Pass, Mississippi River. The survey was completed in 1898 and report submitted on January 7, 1899. This report is printed in the Annual Report of the Chief of Engineers for 1899, page 1863.

The item in the river and harbor act approved March 3, 1899, making appropriation for improving outlet of the Mississippi River, provided for the appointment of a Board of Engineers to prepare a project for a channel 35 feet in depth throughout Southwest Pass, and appropriated \$20,000 for expenses of the Board. The Board of Engineers appointed under provisions of this act submitted a report and project on January 11, 1900. The report is printed on pages 2287-2302, Annual Report for 1900.

The project of the Board contemplated securing a channel 1,000 feet wide and 35 feet deep at mean low water throughout the Southwest Pass by dredging; the construction of 2 jetties to maintain the channel; the construction of sills across Cubits Gap, The Jump, and Baptiste Collets Canal; the closing of all minor outlets below the forts; the construction of a dredge in addition to the one provided for by the river and harbor act of March 3, 1899, and the sundry civil act of June 6, 1900, under appropriation for improving outlet of the Mississippi River; other necessary plant, such as tugboats, barges, tracks, buildings, etc., and the purchase of land at the shore ends of the jetties; the whole estimated to cost \$6,000,000, and \$150,000 additional per annum for maintenance.

In accordance with the report of this Board the river and harbor act of June 13, 1902, appropriated \$750,000, and authorized continuing contracts to be made to the amount of \$2,750,000 additional, toward the prosecution of the project, at the same time authorizing the Secretary of War, in his discretion, to modify the plans described in the report of the Board. Material modifications in the plans of the jetties have been made under this authority, and they are now located as shown on the map printed with Appendix S 2 of this report.

The amount for which contracts were authorized in 1902 has been appropriated. The river and harbor act of March 2, 1907, appropriated \$1,000,000 additional and authorized contracts to the further amount of \$1,500,000, which is yet to be appropriated.

The project for the expenditure of the above amounts contemplates the construction of a dredge, dredging, purchase of land, and construction of 2 jetties to be built of mattresses and stone with concrete superstructure.

Dredging has been carried on since April 20, 1905, by the U. S. dredge *Barnard*, built for this work, except during periods when the dredge was undergoing repairs, etc.

All of the land below or south of Pilottown, on the east bank, and all that below the United States reservation on the west bank of Southwest Pass, containing about 1,275 acres, were acquired on July 10, 1903, for use in connection with the work.

Contract was entered into July 16, approved July 31, 1903, for construction of the 2 jetties. The laying of foundation mats in the

east jetty was commenced on December 31, 1903, and in the west jetty on August 30, 1904. To June 30, 1907, the work done in constructing both jetties is shown on the progress sketch printed with Appendix S 2 of this report.

The amount expended on this work to June 30, 1907, was \$3,117,-653.01.

On account of the advance of the crest of the bar at Southwest Pass since the date of the survey of 1898, on which the estimates for this improvement were based, it became necessary to make provision for increasing the length of the jetties to correspond with this advance. This was done by supplemental contract dated July 18, 1905, the increased cost of the jetties on this account being estimated at \$465,000.

The amount of money available and pledged and not covered by contracts at the end of the fiscal year is about sufficient to cover the cost of dredging with two dredges, expenses of administration and inspection, and reasonable contingencies. As recognized by the Board on Southwest Pass in its report of January 11, 1900, and as since borne out by experience, this work is "one more than ordinarily liable to special difficulties which do not admit of calculation, such as the effects of storms, unfavorable foundations, and uncertain action of the river current," and the amount of funds available for contingencies should be unusually large.

Plans and specifications for constructing sill across Cubits Gap and The Jump, and placing additional mattresses on and building up the sill across the head of Pass a Loutre, Mississippi River, were approved May 17, 1907. The work was advertised May 21, 1907, bids to be opened July 6, 1907.

Specifications for dredging 15,000 feet of the channel at the mouth of Southwest Pass, to secure a depth of 35 feet at mean low tide, for a width of 500 feet, involving the removal of about 2,400,000 cubic yards of material, were submitted to the Department May 14, 1907.

These specifications had not been approved at the end of the fiscal year.

It is proposed to apply the amount estimated that can be profitably expended in fiscal year ending June 30, 1909, to the prosecution of dredging operations, by contract and otherwise, as may be found most economical and advantageous to the United States, with a view of obtaining a minimum depth of 35 feet at mean low tide, as contemplated by the original project; to the closing of the outlets in Southwest Pass; to the removal of the Eads sill at head of the pass; to the construction of the plant that will be necessary in the maintenance of the improvement, and to the payment of other expenses pertaining to the general work of improvement under the approved project. The uninterrupted prosecution of dredging operations is of paramount importance; hence it is greatly desired that the funds be made available so that this work may be continued and completed as early as practicable. The amount asked for is the balance of the amount pledged by Congress for the work of improvement under this project.

July 1, 1906, balance unexpended-----	\$1, 096, 517. 30
Amount appropriated by river and harbor act approved March 2, 1907-----	1, 000, 000. 00
	<hr/> 2, 096, 517. 30
June 30, 1907, amount expended during fiscal year, for works of improvement-----	736, 530. 90
July 1, 1907, balance unexpended-----	1, 359, 986. 40
July 1, 1907, outstanding liabilities-----	106, 660. 57
	<hr/> 1, 253, 325. 83
July 1, 1907, balance available-----	<hr/> 197, 583. 46
Amount (estimated) required for completion of existing project-----	<hr/> 1, 500, 000. 00
<hr/>	
{ Amount that can be profitably expended in fiscal year ending	
{ June 30, 1909, for works of improvement, in addition to the	
{ balance unexpended July 1, 1907-----	
{ Submitted in compliance with requirements of sundry civil act	
{ of June 4, 1897.	
	1, 500, 000. 00
(See Appendix S 2.)	

### 3. *Examinations and surveys at South Pass, Mississippi River.*—

The act of Congress approved March 3, 1875, required examinations and surveys to be made at South Pass, Mississippi River, and reports upon the depth of water and width of channel secured and maintained from time to time in said channel, together with such other information as the Secretary of War might direct. The act of August 11, 1888, made an annual appropriation of \$10,000 for this work. The river and harbor act approved June 13, 1902, contains the following:

The provisions of the act of March third, eighteen hundred and seventy-five, and of the act of August eleventh, eighteen hundred and eighty-eight, with regard to examinations and surveys at South Pass, mouth of the Mississippi River, shall remain in force as fully as though they were herein reenacted in express terms, notwithstanding the termination of the contract with the late James B. Eads and associates.

Up to January 29, 1901, the work of making examinations and surveys at South Pass was carried on under the provisions of the acts of March 3, 1875, and August 11, 1888. From January 29, 1901, to June 30, 1902, examinations and surveys were made with funds appropriated by act of June 6, 1900, for maintenance of South Pass channel.

Since June 30, 1902, under the act of June 13, 1902, repeated surveys have been made of the shoaler localities in South Pass. Complete surveys of the jetty channel and of the channel beyond the ends of the jetties to deeper water in the Gulf were made each month during the fiscal year. A detailed annual survey was made of the 14 miles of channel from the main river to deep water in the Gulf.

Discharge measurements were made of each of three passes during high water.

The expenditures during the year amounted to \$8,929.88, including \$429.88, outstanding liabilities at the beginning of the year, and were for services.

<sup>a</sup> Balance unexpended, \$1,096,487.34, as shown by Annual Report for 1906, is in error.

The total amount expended upon this work to June 30, 1907, was \$311,772.97. These figures can not be taken as being absolutely accurate, because the records prior to the act of June 13, 1902, are somewhat confused and do not seem to have been kept in sufficient separate detail to show the exact expenditures for surveys in the early years of this improvement. The amount given may be accepted as within a few dollars of the actual expenditure.

*Statement of expenditures on account of appropriation for examinations and surveys at South Pass, Mississippi River, from July 1, 1906, to June 30, 1907, inclusive, made in compliance with the river and harbor act of June 13, 1902.*

Services ----- \$8, 929. 88

APPROPRIATION FOR FISCAL YEAR 1906.

July 1, 1906, balance unexpended ----- \$429. 88  
June 30, 1907, amount expended during fiscal year ----- 429. 88

APPROPRIATION FOR FISCAL YEAR 1907.

July 1, 1906, amount appropriated by river and harbor act of June 13, 1902, for fiscal year 1907 ----- \$10, 000. 00  
June 30, 1907, amount expended during fiscal year ----- 8, 500. 00

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July 1, 1907, balance unexpended ----- 1, 500. 00  
July 1, 1907, outstanding liabilities ----- 1, 500. 00  
July 1, 1907, total cost of operations during fiscal year ----- 10, 000. 00

(See Appendix S 3.)

4. *Maintenance and improvement of South Pass channel, Mississippi River.*—The act of Congress of March 3, 1875, amended by acts of June 19, 1878, and March 3, 1879, made provision for the construction by James B. Eads, or his representatives; of jetties and other works in South Pass to secure and maintain a channel 26 feet in depth through the pass, and through the jetties at the mouth of the pass channel "twenty-six feet in depth, not less than two hundred feet in width at the bottom, and having through it a central depth of thirty feet without regard to width." A contract was made for the maintenance of such channel for a period of twenty years.

On January 28, 1901, this contract expired, and the work of maintenance is being continued under the provisions of the emergency river and harbor act of June 6, 1900, which provides that at the termination of the contract with the representatives of the estate of James B. Eads, deceased, the Secretary of War shall take charge of and maintain the channel, jetties, and auxiliary works at South Pass, for which a sum not to exceed \$100,000 per year is appropriated until otherwise provided by law.

The river and harbor act of June 13, 1902, appropriated an additional sum of \$75,000 for the purchase of land at South Pass, for dredging, and for other necessary expenses to maintain the channel with the utmost efficiency. The act of March 3, 1905, authorized contracts to be entered into for materials and work for the improvement of this channel not to exceed in the aggregate \$50,000, exclusive of the amounts heretofore provided by law.

The river and harbor act of March 2, 1907, appropriated \$50,000 for maintenance of improvement and authorized entering into con-

tract for the improvement and maintenance of the channel to an amount not exceeding \$50,000 (yet to be appropriated), to be expended during the fiscal year ending June 30, 1909, both of which amounts are in addition to and exclusive of the regular annual appropriation of \$100,000.

From January 29 to June 30, 1901, from May 26 to October 4, 1902, and from February 15 to August 24, 1903, the channel was maintained by dredging with the U. S. dredge *Beta*, belonging to the Mississippi River Commission.

From July 2 to 25 and from October 5 to 26, 1901, dredging was done by the U. S. dredge *Sabine*. No dredging in the channel through South Pass was done from October 26, 1901, to May 26, 1902, from October 17, 1902, to March 23, 1903, and from August 24, 1903, to October 24, 1904.

From September 18 to October 17, 1902, from April 5 to August 17, 1903, from January 30 to March 16, and from July 15 to August 19, 1904, the dredge *Sabine* was employed in dredging the channel beyond the ends of the jetties.

The dredge *Benyaurd*, built under the appropriations for improving passes of the Mississippi River and improving Southwest Pass, Mississippi River, arrived in New Orleans on October 12, 1904, and began dredging in the channel beyond the ends of the jetties on October 24, 1904. Since that date she was operated in South Pass and the channel beyond the ends of the jetties, except for periods when she was undergoing repairs or alterations or coaling, to July 14, 1906.

Repair work on jetties and auxiliary works was commenced August 5, 1901. These works have been maintained in good condition since that time by the addition from time to time, as required, of willows, stone, piles, and waling timber.

The lands along both sides of South Pass from Head of Passes to the Gulf, containing about 6,994 acres, together with the buildings thereon, were acquired by purchase July 8, 1903, the price paid being \$35,000.

Experience has shown that in order to maintain the channel with the "utmost efficiency" and to meet the demands of the commerce of the port of New Orleans, the amount of the annual appropriation authorized by the act of June 6, 1900, should be increased. The annual amount required to be expended for the maintenance of the jetties and the auxiliary works is reasonably constant, but that required for dredging is variable, depending on conditions which are contingent upon the stage of the river. If other funds than the \$100,000 provided by the act of June 6, 1900, had not been available during the past fiscal year it is probable that dredging operations would have had to be suspended and the work of maintenance considerably curtailed. In order to properly provide for all probable contingencies, the annual appropriation for this work should be increased to \$150,000.

The sum of \$776,727.47 was expended on this work from January 29, 1901, to June 30, 1907.



*Comparative statement of receipts and shipments for seven years for the port of New Orleans, La.*

Year ending December 31—	Tons.	Change in tonnage from previous year.	
		Increase.	Decrease.
1900.....	2,778,645		403,095
1901.....	4,213,869	1,440,224	
1902.....	3,385,686		828,183
1903.....	3,062,506		323,180
1904.....	2,853,926		208,580
1905.....	3,478,976	625,050	
1906.....	4,023,156	544,180	

Since the United States took charge of the maintenance of the channel, January 29, 1901, there has been a general increase in the available navigable depth of 2 feet, the maximum draft that can be carried on June 30, 1907, being 28 feet.

The usual variation of level of water surface is from zero at the mouth to 2½ feet at the head of the pass, due to the stage of the river, and from 1.1 feet at the mouth to 0.7 foot at the head, due to tide.

No detailed data or statistics are at hand showing the effect on freight rates of the increased depth of channel. The number of deep-draft steamers has increased, and, being able to carry full cargoes, the earnings and business of the port of New Orleans have increased and the freight rates decreased. The magnitude of the commerce of the port of New Orleans is best illustrated by the tabulated commercial statistics above, the gain in round numbers in the commerce of 1906 over that of 1905 being 544,180 tons. These figures are necessarily incomplete, as it is impracticable to secure statements covering all the receipts and shipments for any given period. It may be safely assumed, however, that the total greatly exceeds that shown in the above comparative statement.

## APPROPRIATION FOR FISCAL YEAR 1906.

July 1, 1906, balance unexpended.....	\$9,598.52
June 30, 1907, amount expended during fiscal year.....	9,598.52

## APPROPRIATION FOR FISCAL YEAR 1907.

July 1, 1906, amount appropriated by emergency river and harbor act of June 6, 1900.....	\$100,000.00
Miscellaneous receipts during fiscal year deposited to credit of the appropriation.....	24.00
Transferred by Treasury Department from appropriation for repairs and incidental expenses of light-houses, 1907, on account reimbursement of appropriation for maintenance of South Pass channel, Mississippi River, 1907, on account services rendered by Engineer Corps in driving fender piles at South Pass light-house depot wharf.....	8.14
Amount deposited to credit of this appropriation by chief signal officer, Atlanta, Ga., as reimbursement of expenses incurred by Engineer Corps in testing cable for the Signal Corps.....	6.84
	100,038.98
June 30, 1907, amount expended during fiscal year.....	90,290.22
July 1, 1907, balance unexpended.....	9,748.76
July 1, 1907, outstanding liabilities.....	\$7,298.76
July 1, 1907, amount covered by uncompleted contracts.....	2,450.00
	9,748.76

## APPROPRIATION FOR MAINTENANCE OF SOUTH PASS CHANNEL, MISSISSIPPI RIVER.

July 1, 1906, balance unexpended.....	\$50,000.00
Amount appropriated by river and harbor act of March 2, 1907.....	50,000.00
	<hr/>
June 30, 1907, amount expended during fiscal year.....	100,000.00
	49,870.69
	<hr/>
July 1, 1907, balance unexpended.....	50,129.31
July 1, 1907, outstanding liabilities.....	12,285.00
	<hr/>
July 1, 1907, balance available.....	37,844.31
	<hr/>

{ Amount that can be profitably expended in fiscal year ending June 30, 1909, in addition to the balance unexpended July 1, 1907, for maintenance of improvement, in addition to regular annual appropriation of \$100,000..... 50,000.00

{ Submitted in compliance with requirements of sundry civil act of June 4, 1897.

(See Appendix S 4.)

5. *Bayou Lafourche, Louisiana.*—Bayou Lafourche is an outlet of the Mississippi River, forming a junction 70 miles above New Orleans. It is about 105 miles long and flows into the Gulf of Mexico. In its original condition it was obstructed by logs, snags, and overhanging trees. The project of 1879 provided for the removal of such obstructions to improve low-water navigation. Work under this project was carried on until 1885, with appropriations aggregating \$30,000.

The project of June 11, 1886, provided for the construction of a lock to connect the bayou with the Mississippi River and for dredging a channel 75 feet wide and 5 feet deep at mean low water of the Gulf, at an estimated cost of \$450,000, and \$8,000 annually thereafter for maintenance. Work under this project was confined to dredging to maintain low-water navigation, the appropriations at any one time being insufficient to warrant the commencement of the lock and the exigencies of commerce not permitting a suspension of the dredging.

The project of 1886 was modified on September 23, 1896, and held in abeyance the construction of the lock, restricting operations to dredging to maintain low-water navigation, at an estimated cost of \$25,000 per annum.

Dredging operations have been in progress since 1896, but the improvement is not permanent, as sand bars form each year after the subsidence of floods in the Mississippi River.

The amount expended on this work up to June 30, 1907, was \$258,079.67.

The navigation of Bayou Lafourche is at present obstructed by a dam placed across the head of the bayou at its junction with the Mississippi River by levee boards of the State of Louisiana, under authority of the act of Congress approved June 13, 1902. The time for the removal of this dam was extended to January 1, 1910, by the river and harbor act of March 2, 1907.

No expenditures were made during fiscal year ending June 30, 1907.

The maximum draft that can be carried on June 30, 1907, at mean low water is  $3\frac{1}{2}$  feet at the mouth, the usual variation of the water surface being between one-half and 1 foot. The bayou is navigable

its entire length by flatboats and log rafts, but, as stated elsewhere, connection between the bayou and the Mississippi River is at present obstructed by a dam.

The effect of the project on freight rates is not definitely known.

*Comparative statement of receipts and shipments for ten years.*

Date.	Tons.	Change in tonnage from previous year.	
		Increase.	Decrease.
Year ending May 31—			
1898.....	269,398	52,106	
1899.....	206,516		62,882
Calendar year—			
1899.....	157,258		49,258
1900.....	210,315	53,057	
1901.....	137,357		72,958
1902.....	132,745		4,612
1903.....	94,351		38,394
1904.....	66,839		27,512
1905.....	94,320	27,481	
1906 <sup>a</sup> .....	59,092		42,228

<sup>a</sup> It was impracticable to obtain complete commercial statistics.

July 1, 1906, balance unexpended..... <sup>a</sup> \$1,920.33  
 July 1, 1907, balance unexpended..... 1,920.33

(See Appendix S 5.)

6. *Bayou Plaquemine, Grand River, and Pigeon bayous, Louisiana.*—Prior to 1867 the largest steamboats could pass through Bayou Plaquemine into Grand Lake and other connecting water routes, but at that time the police jury of Iberville Parish closed the bayou by means of a dam, shutting out the waters of the Mississippi. Grand River and Pigeon bayous were obstructed by snags, logs, overhanging trees, and sand bars.

The present project is based upon legislation by Congress, according to project and estimate submitted February 11, 1887, and provides for dredging a channel in Bayou Plaquemine 60 feet wide and 6 feet deep from deep water up to the Plaquemine dike, constructing a lock to connect the bayou with the Mississippi River, securing the mouth of the bayou from further caving, and removing obstructions from Grand River and Pigeon bayous; total estimated cost, \$1,708,250, subsequently increased to \$1,740,000.

The project of 1887 was modified on April 10, 1899, to allow for dredging Bayou Plaquemine to a depth of 10 feet and a width of 125 feet.

The protection of the bank of the Mississippi River at the mouth of the bayou was added to the improvement in 1888, and in act of July 13, 1892, the improvement of Grand River and Pigeon bayous was also incorporated therein.

<sup>a</sup> The balance unexpended July 1, 1906, \$1,934.26 as shown by report for fiscal year ending June 30, 1906, is in error. The correct balance unexpended was \$1,920.33. The discrepancy arose on account of error in statement of amount expended during fiscal year 1906, which should have been \$88.93 instead of \$75.00, as stated in the report.

The act of June 3, 1896, authorized continuing contracts to be entered into to complete the project of improvement not to exceed \$1,173,250, exclusive of the amounts therein and previously appropriated. Of this amount \$1,160,000 was subsequently appropriated. By act of March 3, 1905, \$35,000 was appropriated for maintenance of improvement, and contracts not to exceed \$100,000, exclusive of the amounts theretofore appropriated, were authorized for completing improvement. The latter amount was appropriated by sundry civil act of June 30, 1906.

The river and harbor act of March 2, 1907, appropriated \$100,000 "for construction of a dredge and maintenance."

Dredging was carried on in Bayou Plaquemine in 1890, 1891, 1892, and 1894, resulting in securing a channel 6 feet deep and 60 feet wide from the mouth to the railroad bridge.

Contract for the rectification of Bayou Plaquemine under the modified project of April 10, 1899, was entered into July 15, 1899. To June 30, 1906, 506,630 cubic yards of material had been removed in accordance with the terms of the contract. In addition, 16,500 cubic yards was removed under supplemental contract from a portion of the channel which had shoaled. A partial channel was dredged through portions of the bayou up to the dike at the bayou approach to the lock, and work was suspended on June 27, 1905, until the lock shall have been opened to navigation, when work will be resumed and the material deposited in the Mississippi River.

An allotment of \$75,000 was made from the appropriation of 1888 for securing the bank of the Mississippi River at the head of the bayou. Five submerged spur dikes, placed at intervals of about 900 feet, with intervals protected by revetment, were completed in 1894. These dikes and revetments form a continuous protection 1,400 feet long below the site of the lock and 1,200 feet above, with an interval of 500 feet opposite the lock site left for excavating the necessary channel to the lock. On November 30, 1901, and January 29, 1902, two mattresses, 400 by 600 feet and 400 by 450 feet, respectively, were sunk in the river and heavily loaded with stone for protection of the banks near the proposed approach to the lock.

In 1893, 1894, and 1897 obstructions were removed from the mouth of Bayou Sorrel and down Grand River through Pigeon Bayou to Grand Lake, a distance of 30 miles. Flat Lake, at the mouth of Grand River, was dredged in 1893 and 1897.

Work of dredging and removing obstructions from Grand River was carried on until April 20, 1901. Obstructions were removed from the mouth of Bayou Plaquemine to 2 miles below Bayou Pigeon, and at Bay Natchez, a distance of 30 miles. A channel 50 feet wide and 10 feet deep was dredged through Flat Lake and Bay Natchez, the channel through Flat Lake being completed on January 30, 1903, and through Bay Natchez on May 14, 1904.

In 1891 a project for the construction of a lock was submitted, but the funds available were insufficient to warrant its commencement at that time. The Board of Engineer officers appointed to prepare plans and specifications estimated the cost of the lock at \$700,000. Revised plans and specifications for the construction of the lock and

approaches were approved October 27, 1897, and December 2, 1897, respectively, and a continuing contract for the work was entered into May 28, 1898. The work was commenced in August, 1898. Under this contract the floor and walls of the lock were completed, and miter sills, inlet pipes, and snubbing hooks placed. By direction of the Chief of Engineers the contract was annulled upon payment of the retained percentages and other items, aggregating \$24,236.41. Revised plans for construction of lock gates and of the approaches to the lock, including excavation and fill, were approved on June 11, 1903.

For the approach to the lock 1.25 acres of land on the north side and 0.31 acre on the south side were purchased August 24, 1900, for \$7,500.

A protection levee was built, under contract, from the northeast corner of the lock to connect with the main levee system in front of the lock. The work was completed August 8, 1902.

The contract for the lock gates was completed May 5, 1906, the gates being accepted on that date.

The contract with the Otis Elevator Company, dated November 18, 1899, for furnishing and erecting operating machinery and power house was completed August 31, 1906. The total cost of the work under this contract was \$114,000. The amount expended under this contract during the fiscal year was \$64,533.70.

A contract was entered into February 13, 1905, for constructing protection levee and making a portion of the fill behind the lock walls. The work was commenced in March, 1905, and was completed January 28, 1907. The total quantity of material placed under this contract was 39,940 cubic yards, costing \$23,564.60. The amount expended under this contract during the fiscal year was \$5,518.70.

A contract was entered into June 6, 1905, for construction of the approach at the bayou end and part of the approach at the river end of the lock. Work under this contract was commenced on October 10, 1905, and at the end of the fiscal year the excavation had been practically completed, and a total of 1,351 piles had been driven—712 35-foot and 639 50-foot. The amount expended under this contract during the fiscal year was \$68,037.01, making a total expended to June 30, 1907, of \$86,331.59.

A contract was entered into August 7, 1906, for excavation and construction of river approach and back fill of lock. Work under this contract was commenced in September, 1906, and at the end of the fiscal year a total of 29,650 cubic yards of earth had been excavated and 637 50-foot piles had been delivered. The total expended under this contract during the fiscal year was \$19,727.71.

The sum of \$1,523,051.81 had been expended on this improvement to June 30, 1907, including \$1,000 withdrawn by the Chief of Engineers June 20, 1901, for office expenses.

For maintaining the dredged channel through Bayou Plaquemine and Grand River and for removing sediment from the lock chamber the construction of a dredge was authorized by river and harbor act of March 2, 1907. In the estimate for this work it was proposed to expend \$60,000 for the dredge and to operate same for two years at \$15,000 per year; contingencies, \$10,000.

A Board of Engineer officers constituted by Special Orders, No. 20, Office Chief of Engineers, May 7, 1907, to examine and report upon certain matters connected with this improvement, met at New Orleans, La., May 22, visited the work at Plaquemine on May 23, and submitted its report May 24, 1907.

*Comparative statement of receipts and shipments for ten years.*

Date.	Tons.	Change in tonnage from previous year.	
		Increase.	Decrease.
Year ending May 31—			
1898.....	76,626	19,571	.....
1899.....	89,301	12,675	.....
Calendar year—			
1899.....	111,750	22,449	.....
1900.....	88,543	.....	23,207
1901.....	283,000	194,457	.....
1902.....	292,000	9,000	.....
1903.....	302,500	10,500	.....
1904.....	318,000	15,500	.....
1905.....	706,000	888,000	.....
1906.....	572,000	.....	134,000

The decrease in tonnage during the past year was due principally to the large decrease in the matter of fuel oil, which was carried from the pipe line at Butte La Rose to the oil station 2 miles below Plaquemine, and pumped from there across the Mississippi River. The plant was not in operation during a large portion of the year.

July 1, 1906, balance unexpended.....	\$422,763.20
Amount appropriated by river and harbor act approved March 2, 1907.....	\$100,000.00
Amount allotted from appropriations for emergencies, acts of March 3, 1905, and March 2, 1907.....	20,000.00
	120,000.00
	542,763.20
June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	162,768.65
For maintenance of improvement.....	8,046.36
	170,815.01
July 1, 1907, balance unexpended.....	371,948.19
July 1, 1907, outstanding liabilities.....	19,909.70
July 1, 1907, balance available.....	352,038.49
July 1, 1907, amount covered by uncompleted contracts.....	217,044.14

(See Appendix S 6.)

7. *Bayou Teche, Louisiana.*—Bayou Teche is an important commercial stream of southern Louisiana, and finds its outlet into the Gulf of Mexico through Atchafalaya River. Prior to improvement it had a depth of 8 feet to St. Martinville, La., but navigation was rendered dangerous by numerous obstructions. Above St. Martinville the bayou was navigable by steamboats during high water. The project of 1870 provided for removal of obstructions from the head to the mouth of the bayou. Work under this project was carried on from 1870 to 1886, the stream being cleared of logs, snags, wrecks, overhanging trees, and a number of bars. The improvement was not permanent, and other obstructions formed.

The project of 1891 provided for the removal of obstructions between St. Martinville, La., and the mouth of the bayou, a distance of about 80 miles. Work under this project has been carried on since 1891, obstructions being removed as appropriations were made.

The project was modified by the river and harbor act approved March 2, 1907, with a view to obtaining a 6-foot navigation to Arnaudville, in accordance with the report submitted in House Document No. 527, Fifty-ninth Congress, first session, at an estimated cost of \$111,000, by dredging, removal of snags, etc., and construction of a lock. The expenditure for a 6-foot navigation to Arnaudville is contingent upon all lands necessary for lock and dam purposes and canal feeders being deeded to the United States free of cost and upon the United States being secured against possible claims for damages resulting from the overflow of lands by reason of the lock and dam improvement or from the draining of Spanish Lake.

No work of improvement was carried on during the past fiscal year, beyond the location of the site for the lock near St. Martinville and the site of the dam across the head of Bayou Vermilion. The land required at site of lock was surveyed by the Citizens' League of St. Martinville, La. At the close of the fiscal year this league was trying to arrange for the transfer to the United States of the land required for lock and dam purposes and canal feeders.

To June 30, 1907, \$92,872.92 had been expended upon this work, of which \$7,579.39 was for maintenance and \$4,293.53 for expenses of resurvey of the bayou and \$81,000 for works of improvement.

The maximum draft that can be carried on June 30, 1907, is about 4 feet. The usual variation of level of water surface is not definitely known.

The bayou is navigable to St. Martinville, 75 miles from its mouth. The effect of the project on freight rates is not positively known.

*Comparative statement of receipts and shipments for ten years.*

Date.	Tons.	Change in tonnage from previous year.	
		Increase.	Decrease.
Year ending May 31--			
1898.....	238,783		64,246
1899.....	286,091	47,308	
Calendar year--			
1899.....	272,975		13,116
1900.....	212,109		60,866
1901.....	335,588	123,474	
1902.....	404,454	72,871	
1903.....	450,642	42,088	
1904.....	362,706		87,836
1905.....	701,243	338,537	
1906.....	706,091	4,848	

July 1, 1906, balance unexpended..... \$3,206.47  
 Amount appropriated by river and harbor act of March 2, 1907..... 130,000.00

133,206.47

June 30, 1907, amount expended during fiscal year, for maintenance of improvement..... 79.39

July 1, 1907, balance available..... 133,127.08

(See Appendix S 7.)

8. *Removing sunken vessels or craft obstructing or endangering navigation.*—An allotment of \$35 was made from this appropriation, act of March 3, 1899, and applied toward payment of expenses incurred in advertising for proposals for removing sunken logs from Bayou Teche, Louisiana. The expenses were paid during the fiscal year.

(See Appendix S 8.)

IMPROVEMENT OF HOMOCHITTO RIVER, MISSISSIPPI, AND OF CERTAIN RIVERS AND HARBORS IN SOUTHERN LOUISIANA AND EASTERN TEXAS.

This district was in the charge of Capt. James F. McIndoe, Corps of Engineers. Division engineer, Lieut. Col. Clinton B. Sears, Corps of Engineers, to July 16, 1906, and Col. E. H. Ruffner, Corps of Engineers, since that date.

1. *Homochitto River, Mississippi.*—About 8 miles above Fort Adams, Miss., the Homochitto enters the Mississippi River. For the first 3 miles from that point it is designated as the "Narrows," and for a distance of 12 miles farther as "Old River." A preliminary examination, made in 1896, showed that the Narrows had a depth of 5 feet at low water and a width of 150 feet, except for a distance of about 1 mile, where the stream is very narrow and shoal. This narrow and shoal portion was obstructed by snags and logs. Old River was about 1,000 feet wide and about 2 feet in depth over the shoalest places at low water. It was clear of obstructions. Above Old River the Homochitto River had a navigable depth of about 8 feet and a width of about 150 feet for a distance of about 45 miles, but it was thickly obstructed by snags, logs, and overhanging trees.

The act of March 3, 1899, appropriated \$16,000 for the removal of obstructions between the mouth of the river and the Yazoo and Mississippi Valley Railway bridge, a distance of about 60 miles, and a project for the work was approved April 18, 1899.

Work under this project was commenced November 27, 1899, and continued until August 13, 1900, resulting in the improvement of the channel for a distance of about 18 miles and a width varying from 60 to 200 feet. Subsequent operations have been for maintenance.

The amount expended to June 30, 1907, is \$17,667.81, of which \$2,186.14 was applied to the maintenance of improvement.

Available funds will be applied toward the construction of a combined dredge and snag boat and to the operation of this boat for the removal of snags, overhanging trees, and other obstructions.

The Homochitto River is navigable in fact, during periods of high water in the Mississippi River, for a distance of about 18 miles, above which point it would be navigable for a farther distance of about 42 miles except that it is thickly obstructed with snags, logs, and overhanging trees. The maximum draft that could be carried, June 30, 1907, over the bar at lower end of Old River, the shoalest part of the locality under improvement, was about  $2\frac{1}{2}$  feet at mean low water. The 5 miles of channel above Old River, which was cleared of obstructions in 1903, has again become badly obstructed by snags.



The usual variation in level of the water surface between high and low water is about 30 feet, the high-water period usually lasting about three and one-half months. No point on the river where the channel has been improved is reached by a railroad, and the project has therefore no effect on freight rates.

No detailed commercial statistics for the calendar year 1906 were available. Circular letters and blank forms for furnishing statistics were sent out, but no replies were received. The commerce consists mainly in the rafting of timber.

On page 393, Annual Report of the Chief of Engineers for 1906, reference is made to previous reports on examinations and surveys, and the act of March 2, 1907, calls for a preliminary examination of the river from its mouth to the Yazoo and Mississippi Valley Railroad.

July 1, 1906, balance unexpended.....	\$2, 393. 44
Amount appropriated by river and harbor act approved March 2, 1907.....	4, 000. 00
	<hr/> 6, 393. 44
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	61. 25
July 1, 1907, balance unexpended.....	<hr/> 6, 332. 19
(See Appendix T 1.)	

2. *Bogue Chitto, Chefuncte River, Bogue Falia, Tickfaw River and tributaries, Amite River, and Bayou Manchac, Louisiana.*—(a) *Bogue Chitto.*—Originally navigation on this stream was impeded by snags, logs, and overhanging trees throughout its entire length, except during very high stages of water. The minimum width of channel was 80 feet and the least depth of water 3 feet.

The present project, adopted in 1890, provided for securing and maintaining a channel 3 feet deep from the mouth of the river to Alford's bridge, near Summit, Miss., a distance of about 100 miles, by closing the west mouth and several small run-out bayous, and by the removal of obstructions and overhanging trees, at an estimated cost of \$55,000.

Owing to the inadequacy of appropriations it has been possible to carry out the above project only as far as Cross River, about 80 miles, which distance had to be cleared periodically to maintain the improvement. On June 30, 1900, the condition of the river permitted of navigation being had by light-draft boats from the mouth of the river to Cross River. Subsequent operations have been for maintenance.

The amount expended to June 30, 1907, is \$27,842.54, of which amount it is estimated \$12,929.94 was applied to maintenance.

Bogue Chitto is not considered worthy of further improvement, the results accomplished by previous expenditures being sufficient for the needs of the commerce on the stream, and further appropriations are not deemed necessary.

The commerce consists mainly of the rafting of logs and timber for the surrounding sawmills. No boats ply regularly on this stream.

Bogue Chitto is navigable in fact for a distance of about 84 miles from its mouth. The only advantage derived from the expenditures for improvement of the stream was the facilitating of the rafting of logs and timber. The maximum draft that could be carried on June 30, 1906, was about 2½ feet. The usual variation in level of the water

surface between high and low water is about 11 feet. The secretary of the railroad commission of Louisiana informs me that points on this stream have no reduction in freight rates on account of water competition.

On page 394, Annual Report of Chief of Engineers for 1906, reference is made to reports on examinations and surveys of this stream.

July 1, 1906, balance unexpended.....	\$157. 46
June 30, 1907, amount expended during fiscal year (transferred to Tickfaw River).....	157. 46

Amount (estimated) required for completion of existing project.....	30,000. 00
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(b) *Chefuncte River and Bogue Falia*.—Prior to improvement of Chefuncte River, a bar, with a depth of only  $4\frac{1}{2}$  feet of water, obstructed the entrance to the mouth of the river. From this point to its junction with the Bogue Falia, a distance of 10 miles, the river was from 300 to 800 feet in width, with a channel 15 feet in depth, navigable for steamers and sailing vessels, but obstructed by snags and overhanging trees. Above this point the stream is not navigable.

Bogue Falia was navigable for small steamers from point of junction with the Chefuncte to Grants Landing, 4 miles above; for sailing vessels drawing 5 feet or less, to Covington, 2 miles farther; obstructed by snags and overhanging trees. Not navigable beyond Covington.

The original project of 1880 provided for dredging through the bar at the mouth of the Chefuncte River, and for the removal of all obstructions between its mouth and Covington on the Bogue Falia, at an estimated cost of \$5,460. It was modified in 1884 to permit of the construction of a breakwater to protect the channel dredged across the bar at the mouth of the Chefuncte River. Estimated cost, \$1,500.

For an account of the improvements under original project and modification, see Annual Report of the Chief of Engineers for 1896, page 1485. Subsequent operations have been for maintenance.

It is proposed to apply the available funds toward the construction of a combined dredge and snag boat and to the operation of said boat for the removal of bars and such snags, logs, and overhanging trees as interfere with navigation between Covington and the mouth of the river.

The amount expended to June 30, 1907, is \$12,364.74, of which \$5,864.74 was applied to maintenance. The expenditures during the past fiscal year were for collection of commercial statistics.

On June 30, 1907, the maximum draft that could be carried over the bar at the mouth of the Chefuncte River was 7 feet, the expenditures for improvement having resulted in an increase of  $2\frac{1}{2}$  feet in depth and 60 feet in width. The head of navigation is Covington on the Bogue Falia, about 16 miles by river from Lake Pontchartrain. The upper part of the stream is so crooked that boats 200 feet long can run only  $12\frac{1}{2}$  miles up the river and boats 110 feet long only 15 miles. The variation in level of water surface between high and low tide is usually about 1 foot, although winds may make a variation of as much as 3 feet.

The only information obtained as to the effect of the project on freight rates is a statement from the secretary of the State railroad

commission that Covington has reduced rates on account of the navigation on the river.

*Comparative statement of receipts and shipments for ten years.*

	Tons.	Change in tonnage from previous year.	
		Increase.	Decrease.
Year ending May 31—			
1896.....	67,680	17,902	.....
1897.....	110,084	42,354	.....
1898.....	99,505		10,529
1899.....	97,789		1,716
Calendar year—			
1899.....	156,500	58,711	.....
1900.....	86,856		69,644
1901.....	92,874	6,018	.....
1902.....	100,768	7,894	.....
1904.....	184,099	83,331	.....
1905.....	222,494	38,395	.....
1906.....	235,727	13,233	.....

On page 395, Annual Report of Chief of Engineers for 1906, reference is made to previous reports on examinations and surveys of these streams.

July 1, 1906, balance unexpended.....	\$472. 05
Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	8,000. 00
	8,472. 05
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	30. 80
July 1, 1907, balance unexpended.....	8,441. 25

(c) *Tickfaw River and tributaries, Louisiana.*—These streams—the Tickfaw, Blood, Natalbany, and Ponchatoula rivers—had a 9-foot channel, navigable for steamers and schooners for an aggregate distance of 38 miles, but obstructed by snags, logs, and overhanging trees.

The original project, adopted in 1881, provided for the removal of obstructions as far as appropriations would permit; estimated cost, \$10,230. The project for maintenance of improvement was approved August 10, 1892, and under these two projects the work has been carried on since 1881.

All obstructing deadheads were removed from the channel from the mouth of the Tickfaw River to Springfield on the Natalbany, and a channel was dredged across a point, which had been a serious obstruction to navigation, just above Springfield.

It is proposed to apply available funds toward the construction of a combined dredge and snag boat and to the operation of this boat for the removal of bars and such snags, logs, and overhanging trees as interfere with navigation.

The amount expended to June 30, 1907, is \$13,990.95, of which it is estimated \$5,990.95 was applied to maintenance.

On June 30, 1907, the maximum draft that could be carried over the bar at the mouth of the Tickfaw River at mean low water was 6 feet. There is at all times water enough in the river to accommodate a draft of 10 feet. The usual tidal variation of level of water surface is about 6 inches, but winds effect a variation of from 1 to 2 feet.

Tickfaw River is navigable in fact to Kemps Landing, about 18 miles from its mouth in Lake Maurepas; Blood River, to S. Tuckers Landing, about 4 miles; Natalbany River, to the parish bridge just above Springfield, La., about 12 miles; Ponchatoula River, to Wadesboro, La., about 5 miles. The expenditures for improvement have been confined to the removal of snags, logs, and other obstructions.

No point on any of these streams is reached by a railroad, and there is no competition in freight rates.

*Comparative statement of receipts and shipments for ten years.*

	Tons.	Change in tonnage from previous year.	
		Increase.	Decrease.
Year ending May 31—			
1896.....	72,851	49,467	.....
1897.....	58,115	.....	14,786
1898.....	75,579	17,764	.....
1899.....	52,961	.....	22,618
Calendar year—			
1899.....	79,300	26,339	.....
1900.....	55,540	.....	23,700
1901.....	56,464	924	.....
1902.....	45,632	.....	10,832
1904.....	86,302	40,670	.....
1905.....	45,429	.....	40,873
1906.....	34,690	.....	10,739

On page 397, Annual Report of Chief of Engineers for 1906, reference is made to previous reports on examinations and surveys of these streams.

July 1, 1906, balance unexpended.....	\$33. 30
Transferred from Bogue Chitto.....	157. 46
Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	6,000. 00
	6,190. 76
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	24. 25
July 1, 1907, balance unexpended.....	6,166. 51

(d) *Amite River and Bayou Manchac, Louisiana.*—Prior to improvement the Amite River was navigable for small steamers for a distance of 45 miles from its mouth and Bayou Manchac for a distance of 10 miles, but both streams were obstructed by snags, logs, and overhanging trees.

The original project, as adopted in 1880 and modified in 1883 and 1888, provided for the removal of obstructions in Bayou Manchac from Hope Villa to the Amite River, and in the latter stream to Lake Maurepas (its mouth), at an estimated cost of \$31,760.

Amite River was improved for a distance of 42 miles from its mouth and Bayou Manchac for a distance of 10 miles from its junction with the former stream. A turning basin was made at the upper limit of improvement in Bayou Manchac.

The work of maintenance has been carried out under the project of 1892 and subsequent projects.

The improvement is not considered permanent, as snags and logs will continue to accumulate and bars will continue to form at the mouths of the streams, thus obstructing navigation.

It is proposed to apply the available funds toward the construction of a combined dredge and snag boat and to the operation of the boat for the removal of bars and such snags, logs, and overhanging trees as interfere with navigation.

The amount expended to June 30, 1907, is \$42,116.99, of which it is estimated \$17,216.27 was applied to maintenance.

On June 30, 1907, the maximum draft that could be carried at mean low water over the bar in Lake Maurepas at the mouth of the river was 6 feet. The usual tidal variation at mouth of river is 6 inches; the level of water surface in Bayou Manchac varies as much as 6 feet. Amite River is navigable in fact to the mouth of Bayou Manchac, a distance of 42 miles, and Bayou Manchac is navigable to Hope Villa, a distance of 10 miles.

The only information obtained as to the effect of the project on freight rates is a statement from the secretary of the State railroad commission that Hope Villa, on Bayou Manchac, has been granted a special tariff, with rates lower than normal ones.

*Comparative statement of receipts and shipments for ten years.*

	Tons.	Change in tonnage from previous year.	
		Increase.	Decrease.
Year ending May 31—			
1896.....	55,103	12,120	.....
1897.....	49,509		5,594
1898.....	54,749	5,240	.....
1899.....	60,305	5,556	.....
Calendar year—			
1899.....	59,850	.....	455
1900.....	25,400	.....	34,450
1901.....	69,918	44,518	.....
1902.....	44,694	.....	25,224
1904.....	120,851	76,157	.....
1905.....	43,371	.....	77,480
1906.....	50,669	7,298	.....

On page 398, Annual Report of Chief of Engineers for 1906, reference is made to previous reports on examinations and surveys of these streams.

July 1, 1906, balance unexpended.....	\$399.52
Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	20,000.00
	20,399.52
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	22.50
July 1, 1907, balance unexpended.....	20,377.02

## CONSOLIDATED.

July 1, 1906, balance unexpended-----	\$1, 062. 33
Amount appropriated by river and harbor act approved March 2, 1907-----	34, 000. 00
	<hr/>
	35, 062. 33
June 30, 1907, amount expended during fiscal year, for maintenance of improvement-----	77. 55
	<hr/>
July 1, 1907, balance unexpended-----	34, 984. 78
	<hr/>
Amount (estimated) required for completion of existing project----	\$30, 000. 00
(See Appendix T 2.)	

3. *Inland waterway from Franklin to Mermentau, Louisiana.*—The project for this waterway was adopted by Congress March 2, 1907, and provides for a channel 5 feet deep and 40 feet bottom width, with appropriate side slopes. The proposed channel is to connect with the Bayou Teche near Franklin, La.; thence to Cote Blanche and Vermilion bays by a dredged canal and existing drainage canals or bayous; thence up Schooner Bayou; thence by a dredged canal to White Lake; across White Lake; thence by a dredged canal to Grand Lake and across this lake to Lake Misere, west of the Mermentau River, at an estimated cost of \$289,292, with an estimated cost for maintenance of \$20,000 per year.

The act of March 2, 1907, appropriated \$89,292, and contracts were authorized to complete the project not to exceed \$200,000, which remains to be appropriated.

Under the general project the right of way must be furnished without cost to the United States. Promises to donate the right of way have been secured from the owners of all lands lying along the route between Grand Lake and Vermilion Bay.

Five routes are under consideration for that part of the proposed channel lying between Bayou Teche and Vermilion Bay. All of these routes must cross the right of way of the Southern Pacific Railroad, and a bridge for the service of the railroad will be necessary.

The amount expended to June 30, 1907, is \$1,198.21, for inspections of the various routes and for the survey.

The appropriation recommended for the fiscal year 1909 will be applied to completion of dredging, in accordance with the adopted project.

The report on the examination of the inland waterway channel is printed in House Document No. 640, Fifty-ninth Congress, second session.

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<sup>a</sup> Applies to Bogue Chitto only.

Amount appropriated by river and harbor act approved March 2, 1907.	\$89, 292. 00
June 30, 1907, amount expended during fiscal year, for works of improvement -----	1, 198. 21
July 1, 1907, balance unexpended -----	88, 093. 79
July 1, 1907, outstanding liabilities -----	306. 35
July 1, 1907, balance available -----	87, 787. 44
Amount (estimated) required for completion of existing project ----	200, 000. 00

{	Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907.-----	200, 000. 00
	Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

(See Appendix T 3.)

4. *Channel, bay, and passes of Bayou Vermilion, and Mermentau River and tributaries, Louisiana.*—(a) *Channel, bay, and passes of Bayou Vermilion.*—Prior to improvement the upper 12 miles of Bayou Vermilion was only 2 feet deep, and its lower portion, through the bay and passes, not less than 5½ feet deep, and had a width varying from 100 to 400 feet. The channel, however, was obstructed by snags, logs, and overhanging trees.

The original project, adopted in 1882, provided for the removal of the obstructions, the erection of guide piling to indicate the limits of the channel over the bars in Vermilion Bay, and for securing a navigable depth of 5½ feet up to the railroad bridge near Lafayette, La.

Project for maintenance (1892) was approved by the Secretary of War August 12, 1892.

The improvement is not considered permanent, as obstructions will continue to form and must be periodically removed.

An examination in June, 1906, showed that the bayou was in good condition below Abbeville, but that obstructions had again formed above Abbeville.

The U. S. steamboat *Ramos* worked in the bayou from December 13, 1906, to January 13, 1907, removing 31 snags and 175 overhanging trees between the mouth of the bayou and Broussard's bridge, 23 miles above Abbeville. Above this point the stream was too narrow and shallow for this boat to work.

The amount expended to June 30, 1907, is \$36,017.88, of which amount \$26,117.88 has been expended under projects for maintenance.

It is proposed to apply the available funds toward the construction of a combined dredge and snag boat and to the operation of said boat for the removal of bars and such snags, logs, and overhanging trees as interfere with navigation.

On June 30, 1907, the maximum draft that could be carried over the bar at mouth of Bayou Vermilion was about 2½ feet and in the upper part of the stream 3½ feet. The usual tidal variations at mouth of bayou is about 1 foot and in upper part about 18 inches. The bayou is navigable to D. O. Broussard's landing, about 20 miles above Abbeville, La., or 46 miles from mouth, although it is obstructed by snags and logs.

The only information obtained as to the effect of the project on freight rates is a statement from the secretary of the State railroad

commission that at Abbeville there are lower rates than to intermediate points, on account of its being located on navigable water.

*Comparative statement of receipts and shipments for ten years.*

	Tons.	Change in tonnage from previous year.	
		Increase.	Decrease.
Year ending May 31—			
1897.....	6,126	.....	6,896
1898.....	8,862	2,736	.....
1899.....	14,969	6,107	.....
Calendar year—			
1900.....	21,150	6,181	.....
1901.....	31,385	10,235	.....
1902.....	37,000	5,615	.....
1903.....	15,157	.....	21,843
1904.....	29,326	14,169	.....
1905.....	28,092	.....	1,234
1906.....	32,025	3,933	.....

On page 399, Annual Report of Chief of Engineers for 1906, reference is made to previous reports on examinations and surveys of this stream, and the act of March 2, 1907, calls for a preliminary examination to Lafayette with a view to obtaining 6 feet of water.

July 1, 1906, balance unexpended.....	\$909.87
Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	7,000.00
	7,909.87
June 30, 1907, amount expended during fiscal year, for maintenance of improvement .....	\$27.75

July 1, 1907, balance unexpended..... 7,082.12

(b) *Mermentau River and tributaries, Louisiana.*—Prior to improvement these streams had depths varying from 7 to 30 feet. The channel through Grand Lake was 6 feet deep, and the depth at the mouth of the river was about 13 feet. The width varies from 70 feet, near Viterboville, to 350 feet at Lake Arthur. The channel was crooked and obstructed by snags and logs.

The original project of 1892 provided for the removal of obstructions in the upper river and the construction of brush dams in the lower river to remove existing mud flats. The estimated cost was \$23,615.25.

With the appropriations of 1892, 1894, and 1896 operations were carried on from December, 1892, to December, 1899, and 38 miles of the channel, from the lower end of Lake Arthur downstream, was cleared of obstructions; two brush dams, 2,500 and 3,000 feet in length, respectively, were built in Mud Lake, and a channel 8 feet in depth and 50 feet in width was cut across the flats in Mud Lake and maintained as the exigencies of navigation required.

An examination made in July, 1906, showed that Bayou Nezpique, the principal tributary, was obstructed with snags and logs and that dredging would probably be required for maintenance of the channel through Grand Lake and Lower Mud Lake. Operations were commenced in Bayou Nezpique with a hired plant on August 21, 1906, and were completed on October 6, 1906. All obstructing snags and



logs were removed from the channel for a distance of 21 miles below Viterboville, La.

The amount expended to June 30, 1907, is \$27,734.47, of which it is estimated that \$11,017.99 was applied to maintenance.

It is proposed to apply the available funds toward the construction of a combined dredge and snag boat and to the operation of this boat for the removal of such bars, snags, logs, and overhanging trees as interfere with navigation.

On June 30, 1907, the maximum draft that could be carried over the flats in Lower Mud Lake, the shoalest place in the channel, was 4 feet at mean low water. The usual variation of the level of water surface in the lower reaches of the river is about  $1\frac{1}{2}$  feet and the extreme variation is about  $2\frac{1}{2}$  feet. Mermentau River is navigable throughout its whole length to about 2 miles above Mermentau, a distance of about 70 miles; Bayou Nezpique, the principal tributary, is navigable to Viterboville, La., a distance of about 25 miles above the head of the Mermentau River; Bayou Plaquemine Brule and Bayou des Cannes are each navigable for distances of about 10 miles.

The only information obtained as to the effect of the project on freight rates is a statement from the secretary of the State railroad commission that at Mermentau there are lower rates than at intermediate points, on account of its being located on navigable water.

*Comparative statement of shipments and receipts for ten years.*

	Tons.	Change in tonnage from previous year.	
		Increase.	Decrease.
Year ending May 31—			
1897.....	12, 210	.....	4, 249
1898.....	18, 650	6, 440	.....
1899.....	22, 236	3, 586	.....
Calendar year—			
1900.....	27, 034	.....	.....
1901.....	29, 291	2, 257	.....
1902.....	50, 326	21, 035	.....
1903.....	63, 690	13, 364	.....
1904.....	45, 866	.....	17, 824
1905.....	42, 413	.....	3, 453
1906.....	61, 634	19, 221	.....

On page 401, Annual Report of Chief of Engineers for 1906, reference is made to previous reports on examinations and surveys of this stream.

July 1, 1906, balance unexpended.....	\$2, 526. 72
Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	18, 000. 00
	20, 526. 72
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	2, 345. 94
July 1, 1907, balance unexpended.....	18, 180. 78

## CONSOLIDATED.

July 1, 1906, balance unexpended-----	\$3, 436. 59
Amount appropriated by river and harbor act approved March 2, 1907-----	25, 000. 00
	<hr/>
	28, 436. 59
June 30, 1907, amount expended during fiscal year, for maintenance of improvement-----	3, 173. 69
	<hr/>
July 1, 1907, balance unexpended-----	25, 262. 90
(See Appendix T 4.)	

5. *Mouth and passes of Calcasieu River, Louisiana.*—Prior to improvement there existed a depth of  $6\frac{1}{2}$  feet over the outer bar at the entrance to Calcasieu Lake. The lake was 15 miles in length, with a depth of 6 feet. The depth of water over the inner bars was  $3\frac{1}{2}$  feet, and from the upper bar to Lake Charles, La., the river was not less than 8 feet deep.

Under the original project of 1872, with the modification of 1881, a channel 8 feet in depth, 70 feet wide, and 7,500 feet in length was cut through the inner bars during 1874, 1882, and 1883, but this channel having shoaled to  $3\frac{1}{2}$  feet it was redredged in 1886, under the project of that year, and a plank revetment to provide against refilling was commenced. The noncompletion of this revetment caused the refilling of the channel.

Appropriations made in 1888, aggregating \$85,000, for the construction of a revetment and parallel jetties, in accordance with the project of 1886, not being sufficient, this sum was increased by \$100,000 in 1892.

The project of 1892, under which the present work is carried on, provides for the redredging of a channel 8 feet in depth through the inner bars and revetting this channel; to construct parallel jetties of brush and stone at the entrance to the outer pass, and to dredge a channel between these jetties to a depth of 12 feet if necessary. The total estimated cost of the jetties was \$600,000.

Under this project the revetment was completed in August, 1893. A channel 8 feet deep and 50 feet wide, connecting deep water in Calcasieu Pass and Lake, was dredged in 1894, 1895, and 1898. Construction of the east jetty was carried on in 1894, 1895, and 1896, and of the west jetty in 1897. In 1900, with an appropriation of \$35,000, the foundation of the west jetty was extended 1,000 feet, making its total length 3,200 feet.

An examination of the channel made in May, 1905, developed that the channel, dredged to a depth of 8 feet in 1903 through the inner pass, had shoaled to less than 4 feet, and that the revetment placed for protection of this channel had almost entirely disappeared.

The channel through the outer pass between the jetties had a depth at low tide of about 10 feet, which is ample for the present needs of navigation, considering the condition of channel through the inner pass.

Under the project for expenditure of amount appropriated by act of March 3, 1905, a survey was made from the mouth of the river to the outer pass; the channel at the inner pass was redredged to a depth of 7 feet and width of 100 feet for a length of 24,000 feet; the channel at the mouth of the river was redredged to a depth of 7 feet and width

of 100 feet for a length of 10,000 feet; the entire channel through the lake was marked by creosoted pile clusters, 54 in number, at intervals of 1,500 feet; and the revetment at lower end of lake (inner pass) was rebuilt for a length of 8,230 feet. Dredging and marking channel were completed, under contract, August 25, 1906, and repairs to revetment April 6, 1907.

The amount expended to June 30, 1907, is \$611,502.45. Of this amount \$577,343.59 has been expended under the present project, of which it is estimated that \$115,602.27 was applied to maintenance. The expenditures during the fiscal year ending June 30, 1907, were all applied to the maintenance of improvement; \$0.45 was derived from refundment of overpayment.

It is proposed to apply available funds toward the construction of a combined dredge and snag boat and to the operation of the dredge for the maintenance of the authorized depths in the channels at the mouth and passes of the river.

The approved project provides for a channel depth of 8 feet through the bars at the head and foot of the lake, but the maximum depth in the lake is only about 7 feet. On June 30, 1907, the maximum draft that could be carried at mean low water through the shoalest part of the channel in Lake Calcasieu was 6 feet, and the usual variation of the water surface is about 1 foot.

The head of navigation in the Calcasieu River is at Jones Bluff, about 58 miles above its mouth, or 28 miles above Lake Charles, La., the depth in the channel being not less than 12 feet. The river empties into Calcasieu Lake, the length of the navigable channel through which is about 17 miles. Calcasieu Pass is about 6 miles long and connects Calcasieu Lake with the Gulf of Mexico, the least depth in the channel being about 10 feet.

The only information obtained as to the effect of the project on freight rates is statements from the secretary of the State railroad commission and from the general freight agent of the Southern Pacific Railroad, that Lake Charles and other points on this river enjoy benefits in the way of reduced freight rates, due to the fact that they are situated on navigable water.

*Comparative statement of shipments and receipts for ten years.*

	Tons.	Change in tonnage from previous year.	
		Increase.	Decrease.
Year ending May 31—			
1897.....	141,029		61,726
1898.....	190,017	48,988	
1899.....	174,651		15,366
Calendar year—			
1900.....	139,580		
1901.....	139,045		535
1902.....	148,483	9,438	
1903.....	194,155	45,672	
1904.....	226,216	32,061	
1905.....	295,067	68,851	
1906.....	314,285	19,168	

On page 402, Annual Report of Chief of Engineers for 1906, reference is made to previous reports on examinations and surveys of this river.

July 1, 1906, balance unexpended.....	\$95, 078. 18
Refundment of overpayment .....	. 45
Amount appropriated by river and harbor act approved March 2, 1907.....	25, 000. 00
	<hr/> 120, 078. 63
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	95, 080. 63
July 1, 1907, balance unexpended.....	24, 998. 00
(See Appendix T 5.)	

6. *Johnsons Bayou, Louisiana.*—This stream empties into Sabine Lake, Texas. Preliminary survey made in 1897 showed a minimum depth of channel of 12 feet and only 2½ feet over the bar at the mouth of the bayou.

The project of April, 1899, provided for dredging a 6-foot channel through the bar at the mouth of the bayou of such width as the appropriation (\$2,500) would permit.

This work was completed during December, 1899, and a channel 6 feet deep and 60 feet wide secured.

No work has been carried on since 1899, none being considered necessary, and the unexpended balance of the appropriation, \$238.65, was carried to the surplus fund in the Treasury on June 30, 1904.

The total amount expended on the original project was \$2,261.35.

*Comparative statement of shipments and receipts for seven years.*

Calendar year.	Tons.	Change in tonnage from previous year.	
		Increase.	Decrease.
1899.....	3, 163	.....	.....
1900.....	3, 594	431	.....
1901.....	4, 363	769	.....
1902.....	2, 951	.....	1, 412
1903.....	2, 612	.....	339
1904.....	4, 574	1, 962	.....
1906.....	2, 840	.....	1, 734

Commercial statistics for the calendar year 1905 were not collected for the reason that no funds were on hand for the improvement of the stream.

Report on examination of this stream will be found on page 1790, Annual Report of the Chief of Engineers for 1897.

Amount appropriated by river and harbor act approved March 2, 1907.....	\$2, 500. 00
July 1, 1907, balance unexpended.....	2, 500. 00

(See Appendix T 6.)

7. *Mouths of Sabine and Neches rivers, Texas.*—Prior to improvement there was 3½ feet of water over the bar at the mouth of the Sabine River and 3 feet over the bar at the mouth of the Neches River. Dredging was carried on at the mouth of the Sabine River in 1880 and 1895, and a channel 60 feet wide and 7 feet deep secured. At the mouth of the Neches River dredging was carried on in 1880, 1889, and 1895, and a channel 50 feet wide and 5 feet in depth for a length of 8,000 feet was obtained. Funds were exhausted before deep water in Sabine Lake was reached. In 1897 the channel at

the mouth of the Sabine River still afforded a depth of 7 feet, while the channel at the mouth of the Neches River had shoaled to 4 feet.

The act of March 3, 1899, appropriated \$10,000 for improving the mouths of these streams, the appropriation to include the expense of reexamination of the proposed channel through Sabine Lake by a Board of Engineer officers.

The Board constituted in compliance with this act submitted, on August 11, 1899, a report on the proposed channel through Sabine Lake, which report will be found in the Annual Report of the Chief of Engineers for 1900, page 2302.

The project approved July 14, 1899, provided for dredging from deep water in Neches River to deep water in Sabine Lake. Under this project an 8-foot channel, 7,829 feet in length, was dredged from the 7-foot contour in Sabine Lake. A part of the appropriation was expended in deepening the channel across the bar at the mouth of the Sabine River.

A project submitted April 23, 1904, and approved by the War Department May 6, 1904, provided for the dredging of an 8-foot channel through Sabine Lake from the mouths of the Sabine and Neches rivers to Taylors Bayou, Texas. This work was advertised and bids therefor were opened July 18, 1904. This project, however, met with so much opposition from those interested in the improvement that the Chief of Engineers, on July 28, 1904, directed that all work under it be suspended.

On October 21, 1904, the Chief of Engineers, by direction of the Secretary of War, authorized the preparation of plans and specifications for dredging a channel 9 feet deep through Sabine Lake at or near the western shore of the lake, as laid down in report printed in House Document No. 634, Fifty-eighth Congress, second session (Annual Report for 1904, p. 1927).

Project was submitted December 16, 1904, and approved January 14, 1905. The work was advertised, and bids therefor were opened February 18, 1905. No favorable bids were received, and, by authority of the Chief of Engineers, all were rejected.

The act of Congress approved March 3, 1905, adopted the project for this improvement in accordance with the document above referred to and authorized that the work be done under continuing contract, at an estimated cost not to exceed \$536,500, with the following provisions: "That the channel may, in the discretion of the Secretary of War, be constructed through the land near the lake for any part of said route," and "that the right of way is furnished without expense to the United States."

Under this project the proposed channel was located, but the negotiations for the right of way failed, the property owners refusing to donate the right of way except under unacceptable conditions. The Chief of Engineers, therefore, on August 2, 1905, directed the preparation of plans and specifications in accordance with estimate "A" (p. 1947, Annual Report for 1904). These plans were approved October 20, 1905; the work was advertised and bids were opened November 27, 1905. Pending action on the award of the contract the owners of land bordering Sabine Lake, who had previously refused to donate the right of way, offered to donate it provided the channel was constructed inland along the lake shore between the Neches River and Taylors Bayou. After a conference held in his

office, the Secretary of War directed that a contract be entered into with the Bowers Southern Dredging Company for the work in accordance with the specifications under which bids were opened November 27, 1905, the contract to "provide for the construction of a canal in Sabine Lake near its west shore, with the added condition that the Government shall, under the terms of the contract, have the right to change the location of said canal from the lake to the adjacent shore in whole or in part, provided that property sufficient for the right of way for such canal on the shore shall be deeded by its owners to the Government free of all charges."

Deeds and abstracts of title were furnished in the spring of 1906, but on account of errors and omissions four of these deeds had not been approved by the Department of Justice on June 30, 1907.

The contractors began work on the Sabine River end of the channel, where no right of way was necessary, on March 1, 1906, and on June 30, 1906, had completed the channel to the Neches River, a distance of about 4 miles. On account of delay in approval of the deeds, a second dredge was not placed on the work until July 5, 1906, when it began dredging at the mouth of Taylors Bayou. The first dredge continued work to June 27, 1907, but because of nonapproval of deeds of right of way the second dredge was withdrawn by the contractors on April 28, 1907. During the year the dredges completed 43,250 linear feet of channel 100 feet wide on bottom and at least 9 feet deep, and there remains about 15,000 linear feet to be completed.

The amount expended to June 30, 1907, is \$304,738, of which \$9,925.29 was expended on original and modified projects prior to operations under existing project, and \$2.60 was derived from the sale of blueprints.

The act of March 2, 1907, authorized the extension of the channel at its southern end with a depth of 9 feet to a junction with the Port Arthur Canal and the widening of the canal in front of Port Arthur, in the discretion of the Secretary of War. The extension and widening were approved by the Assistant Secretary of War on April 24, 1907. The right of way for the proposed extension has been promised by the Port Arthur Channel and Dock Company, but the deed has not yet been executed.

*Comparative statement of shipments and receipts.*

NECHES RIVER.

	Tons.	Change in tonnage from previous year.	
		Increase.	Decrease.
Calendar year—			
1902.....	145,740		
1903.....	151,672	5,932	
1904.....	161,516	9,844	
1905.....	173,504	11,988	
1906.....	178,656	5,152	

*Comparative statement of shipments and receipts—Continued.*

## SABINE RIVER.

	Tons.	Change in tonnage from previous year.	
		Increase.	Decrease.
Year ending May 31—			
1897.....	245,364		25,893
1898.....	275,506	30,142	
1899.....	270,642		4,864
Calendar year—			
1899.....	407,372	137,730	
1900.....	<sup>a</sup> 32,148		375,224
1901.....	459,909	427,761	
1902.....	413,174		46,735
1903.....	325,761		87,413
1904.....	292,184		33,577
1905.....	198,210		98,974
1906.....	409,870	211,660	

<sup>a</sup> Incomplete; full statistics could not be obtained.

On page 406, Annual Report of Chief of Engineers for 1906, reference is made to previous reports on examinations and surveys of the Sabine and Neches rivers.

July 1, 1906, balance unexpended.....	\$469,688.51
Sale of blueprints.....	2.60

	469,691.11
June 30, 1907, amount expended during fiscal year, for works of improvement.....	227,926.51

July 1, 1907, balance unexpended.....	241,764.60
July 1, 1907, outstanding liabilities.....	45.00

July 1, 1907, balance available.....	241,719.60
--------------------------------------	------------

July 1, 1907, amount covered by uncompleted contracts.....	120,340.31
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(See Appendix T 7.)

8. *Operating and care of Port Arthur Canal, Texas.*—This service is provided for by the permanent indefinite appropriation for operating and care of canals and other works of navigation, under the provisions of section 4 of the river and harbor act of July 5, 1884.

Under the provisions of an act of Congress, approved June 29, 1906, there was conveyed to the United States, free of cost, the Port Arthur Canal, the lumber basin, and the turning basin, together with a strip of land along the canal. The deed of conveyance from the Port Arthur Channel and Dock Company was accepted by the Secretary of War on December 13, 1906, from which date the canal became a public water of the United States. Cession of jurisdiction over the property was executed by the governor of the State of Texas on February 27, 1907.

The Port Arthur Canal was built by a company interested in establishing a port somewhat removed from the Gulf. Dredging was begun in March, 1897, and completed to a depth of 25 feet in December, 1899. In 1902 it became necessary to redredge the canal for nearly its entire length, and this work was completed in March, 1903. The channel and dock company then built a dredge which was operated in maintaining the canal for over three years, and has now been purchased by the United States.

A survey of the canal was completed May 10, 1907, and the following table gives a summary of the condition of the canal upon its acceptance by the United States:

	Length.	Average top width.	Width between 20-foot contours.	Maximum depth.	Minimum depth.
	<i>Feet.</i>	<i>Feet.</i>	<i>Feet.</i>	<i>Feet.</i>	<i>Feet.</i>
Canal .....	37,600	200	80	25.1	22.0
Turning basin .....	1,800	625	530	27.1	23.7
Lumber basin .....	1,200	160	100	26.2	23.1

The depths above given are referred to mean low Gulf level, and the usual variation of the tide is  $1\frac{1}{2}$  feet.

The amount expended to June 30, 1907, was \$14,340.47, excluding outstanding liabilities.

For statistics of commerce, see report on improvement of Sabine Pass.

(See Appendix T 8.)

*9. Harbor at Sabine Pass, Texas.*—Prior to improvement there were depths of 18 and 17 feet, respectively, over the two bars in Sabine Pass, opposite the town of Sabine and opposite Fort Point. These bars were about 200 feet long. Throughout the other portions of the pass the least mean depth was 25 feet.

Beyond the shore line at the entrance to the pass there existed a bar about  $3\frac{1}{2}$  miles wide between the interior and exterior 18-foot bottom curves, over which there was not more than 6 feet of water at mean low tide. Channels 12 and 15 feet deep were dredged through this outer bar during 1878 and 1880, under the project of 1873, at a cost of \$325,000, but they soon refilled.

The project of 1882 provided for the construction of parallel jetties at the entrance of the pass, 1,800 feet apart and about 4 miles in length from shore line to deep water in the Gulf, and for dredging the channel between these jetties if necessary. Estimated cost, \$3,177,606.50.

Construction of the jetties began in 1883, and under successive appropriations has been carried on since that date.

The river and harbor act of 1896 authorized contracts for the completion of the project, limiting the cost to \$1,050,000.

Under contract approved June 22, 1897, the east jetty was completed for a length of 21,818 feet, riprap work only was completed for a length of 682 feet, and foundation only for 2,600 feet. The west jetty had a length of 15,560 feet, of which 1,490 feet was only riprap work and 4,950 feet was foundation only. About 3,000 feet of previous work was capped.

Dredging in the channel was carried on, under contract, in 1897, 1898, and 1899, the depth being increased to 25 feet and the width to 100 feet. The channel was again dredged in 1900 and 1901, with an allotment of \$8,000 from the emergency appropriation of June 6, 1900.

Under the act of March 3, 1899, \$150,000 was appropriated for straightening, widening, and otherwise improving the harbor by the removal of oyster reefs and flats between the United States life-saving



station and a point opposite the United States light-house. The work was completed April 18, 1903.

Act of June 13, 1902, appropriated \$25,000 for widening and straightening the main ship channel and increasing its depth from a point 1,000 feet north of the life-saving station to the entrance of the Port Arthur Canal in accordance with report published in the Annual Report of the Chief of Engineers for 1901, page 1915. This work was completed February 27, 1903, and the channel depth was increased to 25 feet at mean low water for an average width of 400 feet.

The act of June 4, 1897, appropriated \$100,000 for the construction of a dredge (the *Sabine*), which was completed January 14, 1901. Since this date the dredge has worked in the channel between the jetties and removed material as follows:

February 8, 1901, to June 30, 1901, 198,800 cubic yards.  
October 28, 1901, to January 15, 1902, 165,140 cubic yards.  
February 17, 1902, to September 12, 1902, 246,205 cubic yards.  
November 3, 1902, to April 2, 1903, 126,420 cubic yards.  
August 19, 1903, to January 16, 1904, 170,155 cubic yards.  
March 18, 1904, to May 12, 1904, 84,050 cubic yards.  
August 22, 1904, to May 12, 1905, 403,650 cubic yards.  
June 22, 1905, to March 31, 1906, 398,580 cubic yards.  
May 31, 1906, to April 30, 1907, 562,443 cubic yards.

The expenses of the dredge from February 17 to include June 13, 1902, were paid from funds advanced by the Kansas City Southern Railway, under authority of the Secretary of War.

The dredge *Sabine* was absent and engaged in emergency work at South Pass, Mississippi River, under authority of the Chief of Engineers, July 1 to October 27, 1901; January 16 to February 17, 1902; September 13 to October 31, 1902; April 3 to August 18, 1903; January 17 to March 17, 1904, and from July 13 to August 19, 1904. She was absent at New Orleans for repairs May 12 to July 12, 1904; May 13 to June 21, 1905; April 1 to March 30, 1906, and May 1, 1907, to the end of the fiscal year, including in each instance time spent in preparing for and making the trip between New Orleans and Sabine Pass.

The amount expended to June 30, 1907, is \$3,777,597.64, of which \$325,000 was expended on previous projects and \$3,452,597.64 on the present project. Of the latter amount it is estimated that \$233,912.99 has been applied to maintenance of improvement; \$2,979.55 has been derived from miscellaneous sources.

The act of March 2, 1907, appropriated \$160,000 for continuing improvement and for maintenance and authorized contracts for materials or work to the amount of \$200,000, yet to be appropriated.

Bids were opened on June 15, 1907, for raising the low sections of east jetty at inner and outer ends to the height of 4 feet above mean low tide, and under date of June 25, 1907, a contract was entered into for this work.

On June 30, 1907, the available depth in the jetty channel was 24 feet over the shoalest place. At favorable stages of the tide vessels have gone out during the year drawing 25½ feet. The usual variation of the tide is 1½ feet. By continued work the dredge *Sabine* is able to maintain only a very narrow channel of about 24 feet depth, and additional work is badly needed toward building up the low portions of the jetties to a height of about 4 feet above mean low tide, and additional dredging, under contract, should be provided for in

order that the full benefits of the improvement may be obtained. This work, in addition to maintenance, may be considered the existing project, and an estimate for completion is carried in the money statement. The estimated entire cost is \$1,016,573.

The amount estimated as a profitable expenditure in fiscal year ending June 30, 1909, will be applied to the completion of the work under the contract referred to above.

*Comparative statement of shipments and receipts for ten years.*

	Tons.	Change in tonnage from previous year.	
		Increase.	Decrease.
Year ending May 31—			
1897.....	87,632	38,746	.....
1898.....	238,400	150,768	.....
1899.....	326,982	88,582	.....
Calendar year—			
1899.....	326,494	.....	488
1900.....	217,489	.....	109,005
1901.....	150,087	.....	67,402
1902.....	689,688	539,601	.....
1903.....	1,315,248	625,560	.....
1904.....	1,792,371	477,123	.....
1905.....	1,779,954	.....	12,417
1906.....	1,904,389	124,435	.....

On page 407, Annual Report of Chief of Engineers for 1906, reference is made to previous reports on examinations and surveys of Sabine Pass.

July 1, 1906, balance unexpended.....	\$39,335.05
Amount appropriated by river and harbor act approved March 2, 1907.....	160,000.00
Reimbursement for damages to dredge and other receipts.....	703.90
	<u>200,038.95</u>

June 30, 1907, amount expended during fiscal year:

For works of improvement.....	\$14,209.30
For maintenance of improvement.....	26,994.77
	<u>41,204.07</u>

July 1, 1907, balance unexpended.....	158,834.88
July 1, 1907, outstanding liabilities.....	3,267.41

July 1, 1907, balance available.....	<u>155,567.47</u>
--------------------------------------	-------------------

July 1, 1907, amount covered by uncompleted contracts.....	259,875.00
Amount (estimated) required for completion of existing project.....	<u>826,573.00</u>

{	Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907.....	200,000.00
	Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

(See Appendix T 9.)

10. *Removing the water hyacinth from waters in Louisiana and Texas.*—Under the provisions of the sundry civil act of June 4, 1897, a Board of Engineer officers, appointed to investigate the extent of obstruction to navigation in the streams of Florida and Louisiana and to determine a method of checking the growth of or removing the water hyacinth, recommended the construction of boats fitted

with crushing machinery and the use of log booms as adjuncts to the boats. (See Annual Report of the Chief of Engineers for 1899, p. 1615.)

Under the act of March 3, 1899, \$25,000 was appropriated for the purchase of a boat, \$1,000 for the construction of log booms, and \$10,000 for operating expenses.

A boat, purchased and fitted with machinery for crushing the hyacinths, was operated in Bayou Plaquemine and contiguous streams from July, 1900, to June, 1901, when funds were exhausted. Approximately 188,800 square yards of plants was removed.

A boom, with a suitable gate to permit of the plants floating out with the tides and to prevent their return, was constructed and placed at the mouth of Bayou Teche, Louisiana.

Act of June 13, 1902, permitted the destruction of the plants by chemical means or otherwise, and the boat was fitted with special machinery designed for spraying the plants with a chemical compound. Operations were carried on in this manner from September, 1902, to May, 1903, and from August to October, 1903. Approximately 522,750 gallons of the compound was sprayed over an area estimated at 3,509,024 square yards of hyacinths.

Bayou Plaquemine and contiguous streams were, at date of cessation of operations (October 26, 1903), practically free from hyacinths.

With funds allotted May 31, 1904, from appropriation of April 28, 1904, the steamboat *Ramos* began spraying operations in Bayou Plaquemine July 8, 1904. By October 31, 1904, when the season's operations were terminated, the following streams were effectively cleared of all obstructing hyacinths: Bayou Plaquemine, Grand River, Bay Natchez, Bayou Goddell, Belle River, Bayou Long, Bayou Grossetete, and Bayou Choctaw. Booms for controlling the hyacinths were placed in Bayou Plaquemine, at mouth of Bay Grossetete, at the head of navigation in Bayou Grossetete, and across Bayou Choctaw. During the summer months a watchman is maintained at the Bayou Plaquemine boom, whose duty it is to require all rafts and boats to clear themselves of hyacinths before passing through.

During the winter of 1904 the *Ramos* was extensively repaired, and fitted with a pile driver and steam capstan.

The act of March 3, 1905, appropriated \$40,000 for the removal of the water hyacinths from the navigable waters of the States of Texas and Louisiana, and projects, approved April 28 and May 15, 1905, provided for continuance of spraying operations in the Plaquemine-Morgan City water route and for the outfitting of a second boat for operations in the Calcasieu River, Louisiana, and in the Sabine and Neches rivers, Texas.

Operations were resumed in Bayou Plaquemine April 8, 1905, and were continued until October 31 in this and connecting streams named above, at which date the condition of the streams between Plaquemine and Morgan City was sufficiently satisfactory to warrant the suspension of further spraying operations for the season. During the entire season a new chemical compound was used, which gave excellent results at greatly diminished cost. In the season's work a total of 227,292 gallons of chemical compound was used, at a cost for chemicals of \$1,098.66. At the price paid in previous seasons for chemical compound this quantity would have cost \$6,818.76. There

was therefore a saving of over \$5,700, which will pay the operating expenses of the *Ramos* and of the hyacinth booms for a season. It is estimated that each gallon of chemical destroyed approximately 10 to 12 square yards of hyacinths.

The steamboat *Hyacinth* (except the hull, which was purchased) was built and equipped by hired labor at the engineer depot at New Orleans at a total cost of \$8,900.

During the year spraying operations were carried on in the streams of the Plaquemine-Morgan City route, resulting in clearing the streams of all obstructing hyacinths. Cow Bayou, a tributary of the Sabine River, Texas, and Bayou des Allemands and contiguous streams, which were completely blocked by hyacinths, were cleared.

In October, November, and December the *Ramos* sprayed in Calcasieu River; in English Bayou, a tributary of the Calcasieu, and in Bayou Vermilion, but the season was too far advanced for good results.

The amount expended to June 30, 1907, is \$100,239.20. It is proposed to expend the available balance in continuing the work of destroying the water hyacinths which become obstructions to navigation.

July 1, 1906, balance unexpended.....	\$24, 666. 94
Amount appropriated by river and harbor act approvtd March 2, 1907.....	10, 000. 00
	<hr/>
	34, 666. 94
June 30, 1907, amount expended during fiscal year, for works of improvement .....	13, 819. 45
	<hr/>
July 1, 1907, balance unexpended.....	20, 847. 49
July 1, 1907, outstanding liabilities.....	773. 19
	<hr/>
July 1, 1907, balance available.....	20, 074. 30
(See Appendix T 10.)	

#### IMPROVEMENT OF CERTAIN RIVERS AND HARBORS IN TEXAS.

This district was in the charge of Maj. Edgar Jadwin, Corps of Engineers, until June 10, 1907, with Capt. John C. Oakes, Corps of Engineers, under his immediate orders from September 15, 1906, and in the charge of Captain Oakes since June 10, 1907. Division engineer, Lieut. Col. Clinton B. Sears, Corps of Engineers, until July 16, 1906, and Col. E. H. Ruffner, Corps of Engineers, since that date.

1. *Galveston Harbor, Texas.*—Galveston Harbor originally embraced an anchorage area of over 1,960 acres, of which 1,500 acres had a depth of more than 20 feet, 1,300 acres had a depth of more than 24 feet, and 460 acres had a depth of more than 30 feet.

The entrance was obstructed by two bars, known as the inner and outer. The natural depth on the inner bar was about 9 feet and on the outer bar about 12 feet. These shallow depths prevented all but the lightest draft vessels from using the harbor, and necessitated the lightering of cargoes to the larger vessels anchored in the deep water beyond the outer bar.

Prior to 1874 the projects for improving the harbor related to dredging operations on a small scale.

The project for the permanent improvement by jetties was adopted in 1874 and modified in 1880 and 1886. Previous to 1886, \$1,478,000

was expended, with an additional sum of \$100,000 subscribed by the city of Galveston in 1883.

The 1886 project provided for a certain depth of 25 feet and a possible depth of 30 feet by constructing jetties to a height of 5 feet above mean low tide and extending them to the 30-foot contour in the Gulf and supplementing the action of the tidal scour by dredging. The estimated cost of this revised project was \$7,000,000.

The expenditures under the above projects resulted in 1900 in a depth of 26 feet at mean low tide on the outer bar, an increase of 14 feet since work began, and a depth of 26 feet at mean low tide on the inner bar, an increase of 16 feet during the same period.

The south jetty extended 35,603 feet and the north jetty extended 25,907 feet. The amount expended on this project was \$7,041,684.42, of which \$97,687.85 was for maintenance of the improvement.

The hurricane of September 8, 1900, damaged the jetties to a considerable extent, and a Board of Engineer officers estimated the cost of repairing same at \$1,500,000. (Annual Report Chief of Engineers, 1901, p. 2018.) Appropriations under this estimate commenced June 13, 1902, since which time \$1,141,382.03 has been expended, of which \$261,003.91 was for maintenance of the improvement.

The act of March 2, 1907, appropriated \$300,000 and authorized continuing contracts for prosecuting the work to the amount of \$700,000 yet to be appropriated. In pursuance of the discretion vested in him by this act, the Secretary of War approved a project for expenditure of the funds appropriated and pledged in obtaining a depth of 30 feet by repairing the jetties, by jetty extension, and by dredging, including construction of a new dredge.

For more extended information, see House Document No. 340, Fifty-ninth Congress, second session, and River and Harbor Committee Document No. 11, Fifty-ninth Congress, second session.

The project for the expenditure of the above amounts includes the completion of the repairs to the jetties at an estimated cost of \$232,000, the construction of a new seagoing dredge, operating dredges, and an extension of the south jetty about 900 feet.

The project is about four-fifths completed.

It is proposed to apply the amount estimated as a profitable expenditure in the fiscal year ending June 30, 1909, to an extension of the jetties and operation of the dredges.

Repairs to the jetties were continued during the year under continuing contract and hired labor, in accord with the act of 1905.

The U. S. dredge *Gen. C. B. Comstock* continued operations during the year, working upon the outer bar when the weather would permit and at other times on the inner bar.

The outer-bar channel, where dredging is done, weather permitting, had at the beginning of the fiscal year 27 $\frac{3}{4}$  feet at mean low water. The last survey of June, 1907, shows a channel depth of 28 $\frac{1}{2}$  feet, an apparent gain of three-quarters of a foot. The ruling depth varies from 27 $\frac{1}{2}$  to 30 feet, according to the weather and length of time the dredge has been at work on the outer bar.

The inner bar has disappeared, leaving a ruling depth of 31 feet at mean low water, an increase of 2 $\frac{1}{2}$  feet since last report. This result has been accomplished by the U. S. dredge *Gen. C. B. Comstock*.

Mean tide fluctuations on outer bar, 2 feet; inner bar, 1.64 feet; Galveston channel, 1.12 feet. Including Galveston channel, 2,420 acres now has a depth of 24 feet and over, and 920 acres has a depth of 30 feet and over.

All the commerce for Galveston channel, Texas City channel, and Galveston ship channel and Buffalo Bayou which comes in from the Gulf or passes out to the Gulf, whether coastwise or foreign, passes through the jetty channel.

A Board of Engineer officers in its report of December 19, 1902, stated that a conservative estimate of the value to the country of the present improvement at Galveston is more than \$10,000,000 per annum.

July 1, 1906, balance unexpended.....	\$231, 069. 85
Amount appropriated by river and harbor act approved March 2, 1907.....	300, 000. 00
Proceeds of sales of condemned property.....	1, 043. 25
Proceeds of sales of charts of Galveston Bay.....	127. 75
Proceeds of sales of contact prints.....	1. 20

532, 242. 05

June 30, 1907, amount expended during fiscal year:

For works of improvement.....	\$125, 278. 67
For maintenance of improvement.....	77, 281. 14
	202, 559. 81

July 1, 1907, balance unexpended..... 329, 682. 24

July 1, 1907, outstanding liabilities..... 7, 277. 55

July 1, 1907, balance available..... 322, 404. 69

Amount (estimated) required for completion of existing project.... 700, 000. 00

Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907.....	700, 000. 00
Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

(See Appendix U 1.)

2. *Galveston channel, Texas.*—This is the channel passing along the wharf front of the city and connecting the same with the jettied entrance channel.

Galveston channel inside the inner bar had originally a depth varying from 20 feet at Fort Point to 30 feet off Twentieth street, and again to 20 feet off Thirty-second street. The width of the channel between the 18-foot curves was about 600 feet. The inner bar had originally a 9-foot depth, but conditions gradually became better until the outer bar with about 12-foot depth became the controlling factor. All vessels drawing over 12 feet had to complete their cargoes after crossing the bar by lightering.

Appropriations by the United States Government for the channel began in 1902, when \$100,000 was appropriated for improving the channel in accordance with the report submitted in House Document No. 264, Fifty-sixth Congress, second session. The act of March 3, 1905, authorized the construction of a dredge (*Col. A. M. Miller*), at a cost not to exceed \$125,000.

The U. S. dredge *Col. A. M. Miller*, aided by the U. S. dredge *Gen. H. M. Robert*, removed during the fiscal year 1,138,318 cubic yards of material, of which 404,981 cubic yards was charged to

maintenance and 733,337 cubic yards to new work of widening the channel.

The act of March 2, 1907, modified the project by providing for the extension of the channel from Fifty-first to Fifty-sixth street, at an estimated cost of \$129,310. (See H. Doc. No. 768, 59th Cong., 2d sess.)

The estimated cost of the project as modified is \$1,714,310.

The project is about two-fifths completed.

Total amount expended on the work of existing project up to the close of the fiscal year ending June 30, 1907, in dredging and dike construction, \$549,675.12, of which \$48,625.75 was for maintenance of the improvement.

Vessels drawing 27 feet and over can now come over the bar at mean low water and up to the wharves. The *Missouri* went out January 6, 1906, drawing 28 feet and 2 inches.

Under contract and with the United States dredges, a channel has been dredged approximately 30 feet deep and 680 feet wide between red beacon and Twenty-ninth street, a distance of 9,630 feet, and 550 feet wide between Twenty-ninth street and the westernmost face of present westernmost slip of the Southern Pacific Railway Company's wharves, a distance of 5,870 feet.

Variation of level of water surface is about 1 foot.

The tonnage for the port of Galveston for the calendar year 1906 amounted to 2,602,465, valued approximately at \$524,017,366.

A sufficient depth and width of channel is a necessary supplement to the deep water between the jetties to enable the vessels to reach the wharves. The work of the past year has put the channel in better condition for service than ever before.

It is proposed to apply the balance available on June 30, 1907, to maintenance and improvement of the existing channel, maintenance of the dike, and the extension of channel and dike to opposite Fifty-sixth street. It is expected that the funds will provide for the continuous operation of the Government dredge and that this will maintain the existing improved channel, widen it, and continue it to Fifty-sixth street.

July 1, 1906, balance unexpended.....		\$50, 086. 72
Amount appropriated by river and harbor act approved March 2, 1907.....		200, 000. 00
Proceeds of sales of condemned property.....		21. 88
Proceeds of sales of contact prints.....		1. 05
Rental of dredge <i>Miller</i> .....		169. 97
Refundment of overpayment.....		. 59
		<hr/>
		250, 280. 21
June 30, 1907, amount expended during fiscal year:		
For works of improvement.....	\$35, 056. 29	
For maintenance of improvement.....	19, 702. 15	
	<hr/>	54, 758. 44
July 1, 1907, balance unexpended.....		195, 521. 77
July 1, 1907, outstanding liabilities.....		6, 213. 96
July 1, 1907, balance available.....		<hr/>
		189, 307. 81
Amount (estimated) required for completion of existing project..		<hr/> <hr/>
(See Appendix U 2.)		1, 017, 935. 75

3. *Channel from Galveston Harbor to Texas City, Tex.*—The natural depth over the line of this channel was from 4 to 8 feet. During 1895 and 1896 a channel 16 feet deep was dredged by the Texas City Terminal Company. At the time of the adoption of the present project this channel had shoaled to its natural depth.

The river and harbor act of March 3, 1899, provided for deepening the channel north of Pelican Island from Galveston Harbor to Texas City, Tex., to a depth of 25 feet and a width of 100 feet at the bottom, at a cost not to exceed \$250,000.

Amount expended on the work under this appropriation up to the close of the fiscal year ending June 30, 1905, was \$250,000, from appropriations by Congress and \$4,686.01 deposited by contractors for expenses of superintendence, inspection, etc. The channel was dredged 100 feet wide on bottom and 25 feet deep from Texas City wharves to 25 feet of water in Galveston Harbor, a distance of 34,000 feet. This channel shoaled to such an extent that between February 1 and May 28, 1906, the Texas City Transportation Company removed 698,222 cubic yards of material in maintaining and widening the channel.

The channel has again shoaled during the fiscal year 353,400 cubic yards.

The act of March 2, 1907, appropriated \$60,000 for maintenance of this channel. Of this money \$158.68 has been expended for surveys, etc. Contract has been made for redredging the channel to a depth of 23 feet, work to begin on or about July 1, 1907.

The maximum draft that can be carried June 30, 1907, at mean low tide over the shoalest part of this channel is 13 feet. Variation of water surface is about  $1\frac{1}{4}$  feet.

The effect of the project on freight rates is not known.

The tonnage for the port of Texas City, Tex., for the calendar year 1906 was furnished by the collector of customs, port of Galveston, Tex., and amounted to 58,258 tons, valued approximately at \$3,697,757. The Texas City Terminal Company, of Texas City, Tex., gives the commerce of this port for the same period as 84,315 tons, valued at \$5,738,094.

Amount appropriated by river and harbor act approved March 2, 1907— \$60,000. 00  
June 30, 1907, amount expended during fiscal year, for maintenance  
of improvement ----- 158. 68

July 1, 1907, balance unexpended ----- 59, 841. 32  
July 1, 1907, outstanding liabilities ----- 45. 88

July 1, 1907, balance available ----- 59, 795. 44

July 1, 1907, amount covered by uncompleted contracts ----- 31, 320. 00

(See Appendix U 3.)

4. *Channel to Port Bolivar, Tex.*—The river and harbor act of March 2, 1907, appropriated \$50,000 for obtaining a channel 150 feet wide and 25 feet deep, with increased width at wharf, from Galveston Harbor to Port Bolivar.

This channel will extend from the Gulf and Interstate Railway transfer wharf southerly to Bolivar Roads, a distance of 4,275 feet.

The minimum depth over the line of proposed channel is 8 feet at mean low water.

Variation of water surface is about  $1\frac{1}{4}$  feet.



The channel is used for tugs and barges in the transfer of freight cars to and from Galveston.

Amount expended on existing project to close of fiscal year ending June 30, 1907, \$165.58.

Contract has been let for this work, which is to be completed January 20, 1908.

No commercial statistics have been obtained.

Report on examination is printed in House Document No. 719, Fifty-ninth Congress, first session.

Amount appropriated by river and harbor act approved March 2,

1907 .....	\$50,000.00
June 30, 1907, amount expended during fiscal year, for works of improvement .....	165.58
July 1, 1907, balance unexpended .....	49,834.42
July 1, 1907, outstanding liabilities .....	5.00
July 1, 1907, balance available .....	49,829.42
July 1, 1907, amount covered by uncompleted contracts .....	41,625.00

(See Appendix U 4.)

5. *Galveston ship channel and Buffalo Bayou, Texas.*—The ship channel in Galveston Bay and Buffalo Bayou are two links in the waterway connecting Houston with deep water in Galveston Bay, the other links being the San Jacinto River and the Morgan Canal.

In their natural state these two waterways had a depth of from 4 to 8½ feet, of various widths. The earlier projects for their improvement, adopted in 1871, 1877, 1881, and 1892, provided for a channel 100 feet wide and 12 feet deep. Dredging was carried on for a number of years, furnishing a channel sufficient for the character of vessels then navigating these channels.

In 1892 the Government purchased the Morgan Cut and Canal, 5.43 miles long, for \$92,316.85.

The amount expended on original projects prior to operations under existing projects was as follows:

Ship channel in Galveston Bay (including the purchase of Morgan Cut and Canal. \$92,316.85) .....	\$800,328.16
Buffalo Bayou, Texas .....	210,137.64

Total .....	1,010,465.80
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The existing project, adopted in 1899 (p. 1515, Annual Report Chief of Engineers, 1898), as modified in 1905 (p. 1495, et seq., Annual Report Chief of Engineers, 1905), is as follows:

For completing channel to head of Long Reach, including turning basin 600 feet in diameter, 25 feet deep, side slopes 1 on 2, division 1 (bay), 1 on 3 in divisions 2 and 3 (river), least radius 2,500 feet, 150 feet on bottom in division 1 (bay), 100 feet on bottom in divisions 2 and 3 (river) .....	\$3,170,000
26,000 feet of dike revetment .....	40,000
One hydraulic dredge .....	150,000
Engineering and contingencies (about 10 per cent) .....	340,000
Total .....	3,700,000
Amount available December 1, 1904 .....	150,000
Balance required .....	3,550,000

The act of March 2, 1907, appropriated \$200,000 and authorized continuing contracts for prosecuting the improvement in the sum of \$200,000, yet to be appropriated. Of the cash appropriation, \$50,000 is to be expended for the restoration of the channel from foot of Main street to head of Long reach.

The amount expended on the existing project up to the close of the fiscal year ending June 30, 1907, was \$1,659,544.18, of which \$98,401.60 was for maintenance.

The usual variation of level of water surface is, division 1 (bay division), lower bay, 1.3 feet; upper bay, 0.5 foot; and divisions 2 and 3 (river division), less than one-half foot. In times of flood rises of 12 or more feet occasionally occur in Buffalo Bayou.

During the fiscal year the channel has filled in generally throughout its entire length to the amount of 2,028,000 cubic yards.

In May, 1907, a severe flood occurred, during which a rise of 27 feet at Houston and 16½ feet at Harrisburg was recorded. This flood caused a sloughing of the banks and a change in conditions throughout the channel. While there was a scour of 132,000 cubic yards due to the flood, bars were created and the general condition deteriorated badly.

Before this flood the maximum draft carried was as follows: From Morgan Point to Lynchburg, 17 feet; thence 16½ feet to Harrisburg; thence 7 feet to head of Long reach; thence 4 feet to foot of Main street, Houston.

Since the channel across the bay was dredged a fill of 5,311,000 cubic yards has taken place.

The maximum draft that can be carried on June 30, 1907, at mean low tide is, from Bolivar channel to Redfish, 10 feet; thence to Morgan Point, 12 feet; thence to Lynchburg, 18½ feet; thence 14 feet to Harrisburg; thence 12½ feet to the head of Long reach; thence 5 feet to foot of Main street, Houston.

The effect of this project on freight rates is unknown and is very difficult to determine because of a railroad rate differential in favor of Houston authorized by the railroad commission of the State of Texas.

Partial commercial statistics were given by the Direct Navigation Company, L. F. Allien, and J. J. Hussey, who are the principal carriers using the bayou. They report freight carried to the amount of 132,108 tons.

For number of vessels passing through Morgan Canal, see report on operating and care of Morgan Canal, Appendix 6 of this report.

It is proposed to expend the available funds and the amount estimated as a profitable expenditure in fiscal year ending June 30, 1909, toward dredging a 6-foot channel (Houston division, from foot of Main street to the head of Long reach; completion of work now under way, including turning basin at head of Long reach; easing of bends to 2,500-foot radius; maintenance toward a more uniform depth, and the repair of pile and brush dike in upper bay.

July 1, 1906, balance unexpended-----	\$365, 694. 22
Amount appropriated by river and harbor act approved March 2, 1907-----	200, 000. 00
Proceeds of sales of condemned property-----	. 81
Proceeds of sales of contact prints-----	7. 65
Refundment of overpayment-----	. 74
	<hr/>
June 30, 1907, amount expended during fiscal year, for works of improvement-----	565, 703. 42
	<hr/>
July 1, 1907, balance unexpended-----	307, 806. 41
July 1, 1907, outstanding liabilities-----	52, 311. 82
	<hr/>
July 1, 1907, balance available-----	255, 494. 59
	<hr/>
July 1, 1907, amount covered by uncompleted contracts-----	86, 793. 35
Amount (estimated) required for completion of existing project--	3, 000, 000. 00
	<hr/>
{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907-----	200, 000. 00
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

(See Appendix U 5.)

6. *Operating and care of Morgan Canal, Texas.*—A watchman was stationed at the canal during the past fiscal year.

A statement contained in the report of the local engineer officer shows the items of expenditure, which amounted to \$360, exclusive of liabilities outstanding, amounting to \$30.

(See Appendix U 6.)

7. *West Galveston Bay channel, Texas, and mouth of adjacent streams, including Trinity River, Anahuac channel, Cedar Bayou, Chocolate Bayou, and Bastrop Bayou.*—This project embraced the improvement of the following localities: West Galveston Bay, the Galveston and Brazos Canal, Double Bayou, mouth of Trinity River, Anahuac channel, East Bay Bayou, Turtle Bayou, Clear Creek, Dickinson Bayou, Chocolate Bayou, Bastrop Bayou, Oyster Creek, and the mouths of adjacent streams. (Annual Report Chief of Engineers, 1900, p. 2438 et seq.)

Prior to March 3, 1899, the improvement of West Galveston Bay channel, mouth of Trinity River, and Cedar Bayou had been independent. At that date they were consolidated with the other works, except Anahuac channel, which was added by act of March 3, 1905, and Chocolate and Bastrop bayous, which were added by the act of March 2, 1907. The Brazos River, between Velasco and Richmond, which was included in the improvement for a time, is now covered by a separate appropriation and has been transferred to the Dallas district. The estimated cost of the modified project is \$248,646.34.

The object of this improvement, in part, is to obtain and maintain a navigable channel depth of from 4 to 6 feet across the bars at the mouths of the streams and bayous.

The improvement is intended to develop a light-draft inland navigation which will afford cheap transportation by light-draft steamers and barges to the coast country of Texas.

As a separate appropriation has been made for West Galveston Bay channel and the Galveston and Brazos River Canal, expenditures under this allotment for these works have been stopped.

The effect of these improvements has been generally to decrease freight rates to all points reached by the channels improved.

About two-thirds of the project has been completed.

It is proposed to apply the balance available in dredging and snagging, in accordance with approved project.

More and larger boats, especially power boats with schooner hulls, have been built to utilize the improvement. Most of the points reached are settlements not on railroads, and the improvements are of great importance to their commercial life.

The amount expended on these improvements under present project to June 30, 1907, has been as follows:

Channel across Hannas reef.....	\$681. 91
Double Bayou.....	6, 953. 20
Anahuac channel.....	5, 975. 01
Mouth of Trinity River.....	7, 781. 10
Cedar Bayou.....	6, 946. 15
Clear Creek.....	2. 60
Dickinson Bayou.....	. 30
Bastrop Bayou.....	3, 535. 14
Chocolate Bayou.....	. 55
West Galveston Bay channel.....	15, 201. 82
Galveston and Brazos Canal.....	67, 308. 86
Dredge <i>Gen. H. M. Robert</i> .....	67, 992. 51
Total.....	\$182, 379. 15

## CONSOLIDATED.

July 1, 1906, balance unexpended.....	\$12, 081. 84
Amount appropriated by river and harbor act approved March 2, 1907.....	50, 000. 00
Proceeds of sales of condemned property.....	57. 90
Proceeds of sales of contact prints.....	1. 35
Refundment of overpayment.....	1. 20
	62, 142. 29

June 30, 1907, amount expended during fiscal year:

For works of improvement.....	\$10, 520. 24
For maintenance of improvement.....	4, 589. 31
	15, 109. 55

July 1, 1907, balance unexpended.....	47, 032. 74
July 1, 1907, outstanding liabilities.....	3, 736. 09
July 1, 1907, balance available.....	43, 296. 65

Amount (estimated) required for completion of existing project..... 59, 646. 34

(a) *Channel across Hannas reef (East Bay Bayou).*—This is a channel across Hannas reef, known as Ladies Pass, connecting lower Galveston Bay, East Bay, and East Bay Bayou. The natural depth was 3.5 feet at mean low tide.

Amount expended to June 30, 1907, \$681.91. This expenditure resulted in a channel 7 feet deep at mean low tide and from 40 to 60 feet wide.

Maximum draft that can be carried June 30, 1907, about 3 feet at mean low tide. Variation of water surface, about 1 foot.

It is estimated that 500 tons of vegetables comes out of East Bay Bayou each year and that about one-half as much returns.

(b) *Double Bayou.*—The navigation of this bayou was obstructed by a bar which prevented boats drawing over 2 feet of water entering the bayou.

Amount expended on work of existing project up to the close of the fiscal year ending June 30, 1907, \$6,953.20, exclusive of \$2,711.40 deposited by private parties.

The expenditure resulted in a ruling depth of 6.5 feet and 80 feet wide across the bar. The maximum draft that can be carried June 30, 1907, at mean low water is 4 feet.

The variation of water surface is about one-half foot. The bayou is navigable for 6 miles above the mouth.

It is stated that 40,000 sacks of rice will be brought out of this bayou during the next six months.

All supplies for and produce of the country adjacent to this bayou are carried through this channel.

Amount allotted from appropriation by river and harbor act approved March 2, 1907-----	\$4,000.00
June 30, 1907, amount expended during fiscal year, for works of improvement -----	.55

July 1, 1907, balance unexpended-----	3,999.45
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(c) *Anahuac channel*.—The original depth of this channel was about 3 feet.

Amount expended on work of existing project up to the close of the fiscal year ending June 30, 1907, \$5,975.01.

The expenditure resulted in a channel 16,013 feet long, 80 feet wide, and 7 feet deep, from 6 feet of water in Trinity Bay to 8 feet of water in Browns Pass; also large snags were removed from Browns Pass of Anahuac channel, opening it to navigation, and old bulkhead and obstructions removed from channel. Maximum draft that can be carried June 30, 1907, at mean low tide, 4.5 feet.

The U. S. dredge *Gen. H. M. Robert* excavated 5,828 cubic yards of material from slip at Anahuac, Tex., at a cost of 11.2 cents per cubic yard. This was private work, and was paid for from funds deposited by private parties.

Variation of water surface is about one-half foot.

This channel is used by United States mail boat.

During the year 60,000 sacks of rice were carried through this channel. Also all supplies for and produce of country adjacent.

July 1, 1906, balance unexpended-----	\$263.39
Amount allotted from appropriation by river and harbor act approved March 2, 1907-----	6,000.00

	6,263.39
June 30, 1907, amount expended during fiscal year, for works of improvement -----	138.40

July 1, 1907, balance unexpended-----	6,124.99
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(d) *Mouth of Trinity River*.—This river empties into Galveston Bay through several mouths or passes, opposite each of which a bar existed on which the depth of water did not exceed  $3\frac{1}{2}$  feet at mean low tide.

Under earlier projects, adopted June 18, 1878, and amended May 4, 1899, dredging and snagging were done, and the west jetty at Middle Pass completed to a length of 7,359 feet, and a channel 100 feet wide by 5 feet deep secured at a cost of \$75,900. The channel subsequently shoaled to a ruling depth of  $3\frac{1}{2}$  feet.

Amount expended on the work of existing project up to the close of the fiscal year ending June 30, 1907, \$7,781.10, of which \$4,140.66 was applied to maintenance.

Under present project a channel 80 feet wide and 6 feet deep was dredged a distance of 5,700 feet and a log jam removed from the pass.

Maximum draft that can be carried June 30, 1907, at mean low water,  $4\frac{1}{2}$  feet.

Variation of water surface is about one-half foot.

The improvement of the river above the mouth is under another appropriation.

During the calendar year 1906 produce and other commodities valued at \$283,979 were taken out through this channel, and 10,000 barrels of fuel oil were sent up Old River and mouth of Trinity River, in addition to miscellaneous supplies.

July 1, 1906, balance unexpended.....	\$267. 07
Amount allotted from appropriation by river and harbor act approved	
March 2, 1907.....	1, 000. 00
	<hr/>
	1, 267. 07
June 30, 1907, amount expended during fiscal year, for works of improvement.....	70. 02

July 1, 1907, balance unexpended.....	1,197. 05
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(e) *Cedar Bayou*.—Original project for this improvement was adopted September 19, 1890, and consisted in deepening the channel over the bar by dredging, so as to afford a depth of 5 feet at mean low tide, and protecting the dredged channel by brush and stone walls or jetties. The amount expended on this project was \$32,150.

Amount expended on existing project to close of fiscal year ending June 30, 1907, \$6,946.15.

Under present project a channel 8 feet deep, 80 feet wide for a distance of 1,300 feet between the jetties, and a channel of same depth and width for a distance of 7,390 feet across Cloppers bar to San Jacinto Bay, were excavated.

A total of 307.67 tons of riprap was deposited on the jetties, leaving same in comparatively good condition, with lowest places and gaps filled.

Maximum draft that can be carried June 30, 1907, 4.5 feet.

The rise and fall of tide is about one-half foot, except during freshets. Cedar Bayou is navigable for 17 miles from the mouth.

During the calendar year 1906 48,000 sacks rice came out of this bayou. A large percentage of the bricks used for building purposes in Galveston is brought through this channel.

July 1, 1906, balance unexpended.....	\$179. 02
Amount allotted from appropriation by river and harbor act approved	
March 2, 1907.....	5, 000. 00
	<hr/>
	5, 179. 02
June 30, 1907, amount expended during fiscal year, for works of improvement.....	25. 17
July 1, 1907, balance unexpended.....	5, 153. 85

(f) *Clear Creek*.—Clear Creek empties into Galveston upper bay, but is obstructed at its mouth by a narrow sand bar, on which the depth did not exceed 2 feet. Two miles above its mouth the creek enters a lake 3 miles long and  $1\frac{1}{2}$  miles broad with an average depth

of  $1\frac{1}{2}$  feet. Above the lake the depth increases to 8 and 12 feet, which is carried to 25 miles above the mouth.

Amount expended on existing project to close of fiscal year ending June 30, 1907, \$2.60.

The maximum draft that can be carried June 30, 1907, at mean low tide over the shoalest part of the locality is  $1\frac{1}{2}$  feet. Variation of water surface is three-fourths foot.

It is proposed to excavate a channel 5 feet deep and about 17,000 feet long across the bar and through the lake at an expense of \$8,000.

No commercial statistics have been obtained.

Amount allotted from appropriation by river and harbor act approved	
March 2, 1907-----	\$8,000.00
June 30, 1907, amount expended during fiscal year, for works of improvement-----	.30

July 1, 1907, balance unexpended-----	7,999.70
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(g) *Dickinson Bayou*.—Dickinson Bayou or River empties into Galveston lower bay, about 20 miles northwest of the city of Galveston. Navigation is obstructed by a short bar at its mouth with  $2\frac{1}{2}$  feet of water on its crest. After crossing the bar a depth of 10 feet can be carried up the bayou for 20 miles or more and a depth of 6 feet for a distance of 25 miles from its mouth.

Amount expended on existing project to close of fiscal year ending June 30, 1907, \$0.30.

The maximum draft that can be carried June 30, 1907, at mean low tide over the bar is  $2\frac{1}{2}$  feet.

Variation of water surface is 1 foot.

It is proposed to excavate a channel across the bar from 5 feet in bay to 5 feet in bayou at an expense of \$7,000.

No commercial statistics have been obtained.

Amount allotted from appropriation by river and harbor act approved	
March 2, 1907-----	\$7,000.00
June 30, 1907, amount expended during fiscal year, for works of improvement-----	.30

July 1, 1907, balance unexpended-----	6,999.70
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(h) *Bastrop Bayou*.—Bastrop Bayou empties into Bastrop Bay, which is part of West Galveston Bay. The mouth of the bayou is 5 miles northwest of San Luis Pass and had a long shallow approach with only 10 inches of water on the bar. For 2 miles above the bar the water is shallow, averaging about 2 feet. Above that point there is, in general, a depth of 10 feet, interrupted by three shoals, total length 3 miles, with depth of 2 feet. The stream can be navigated above these shoals for a distance of 20 miles by vessels of light draft.

A channel 400 feet long, 35 to 40 feet wide, and 4 feet deep was cut through the shell reef at the mouth of the bayou by the U. S. dredge and snag boat *Gen. S. M. Mansfield* in 1906 at a cost of \$269.42, this amount being subscribed by interested parties.

Work is being carried on at present to obtain a 3-foot channel at an estimated expense of \$10,000.

Amount expended on work of existing project to close of fiscal year ending June 30, 1907, \$3,535.14.

The maximum draft that can be carried June 30, 1907, at mean low tide is 3 feet from bay to dredge.

Variation of water surface, 1 foot.

No commercial statistics have been obtained.

Amount allotted from appropriation by river and harbor act approved March 2, 1907-----	\$10,000.00
June 30, 1907, amount expended during fiscal year, for works of improvement-----	3,535.14
July 1, 1907, balance unexpended-----	6,464.86
July 1, 1907, outstanding liabilities-----	3,564.19
July 1, 1907, balance available-----	2,900.67

(i) *Chocolate Bayou*.—Chocolate Bayou empties into Chocolate Bay, an arm of West Galveston Bay, about 12 miles north of San Luis Pass. At its mouth there is a bar with 3 feet of water on its crest. Above this bar the depth varies from 7 to 15 feet for 50 miles from its mouth.

Amount expended on work of existing project to close of fiscal year ending June 30, 1907, \$0.55.

The maximum draft that can be carried June 30, 1907, at mean low tide over the shoalest part of the locality is 3 feet.

Variation of water surface, 1 foot.

It is proposed to excavate a channel across the bar from 5 feet in the bay to 5 feet in bayou, at an expense of \$9,000.

No statistics have been obtained.

No work has yet been done on this project.

Amount allotted from appropriation by river and harbor act approved March 2, 1907-----	\$9,000.00
June 30, 1907, amount expended during fiscal year, for works of improvement-----	.55
July 1, 1907, balance unexpended-----	8,999.45

(j) *Channel in West Galveston Bay*.—West Galveston Bay is a body of water covering about 39 square miles and lies between Galveston Island and the mainland. It extends from Galveston Bay to the west end of Oyster Bay and is connected with the Gulf of Mexico by San Luis Pass at the western extremity of Galveston Island and with the Brazos River by the Galveston and Brazos Canal. The natural depth of the bay was from  $2\frac{1}{2}$  to 3 feet. The navigable channel was  $28\frac{3}{4}$  miles long.

The project adopted July 13, 1892, and modified in 1896, contemplated a least depth of 5 feet, at an estimated cost of \$28,998.80.

The amount expended was \$19,775.97. This expenditure resulted in a channel 100 feet wide and 3 to  $3\frac{1}{2}$  feet deep from Galveston Bay to the Galveston and Brazos Canal. Beacons were also erected to define the channel. The channel subsequently shoaled to 18 inches in places.

Amount expended on the work of existing project to close of the fiscal year ending June 30, 1907, \$15,201.82, of which \$1,385.34 was applied to maintenance.

Expenditures under present project have resulted in opening up a channel 3 feet deep at mean low tide and 35 feet wide, and beacons have been constructed to define the channel. The maximum draft that can be carried June 30, 1907, is 3 feet.

Variation of level of water is about 1 foot.

This channel forms part of the inland waterway, and an appropriation has been made for it under that head. Hereafter this work will be reported under the head of "Inland waterway on the coast of Texas."



From records kept by the Gulf, Colorado and Santa Fe Railway Company of vessels passing through the draw of its bridge across West Galveston Bay during the calendar year 1906, 4,260 vessels used the waters of West Galveston Bay.

July 1, 1906, balance unexpended.....	\$3, 750. 57
Proceeds of sales of condemned property.....	58. 34
Proceeds of sales of contact prints.....	1. 35

3, 810. 26

June 30, 1907, amount expended during fiscal year:

For works of improvement.....	\$2, 343. 02
For maintenance of improvement.....	1, 385. 34

3, 728. 36

July 1, 1907, balance unexpended..... 81. 90

July 1, 1907, outstanding liabilities..... 81. 90

(k) *Galveston and Brazos Canal*.—This canal was originally dredged by the Galveston and Brazos Navigation Company. The original cut was 10 miles long (made in 1851–1853), 100 feet wide at bottom, and 6 feet deep. Steamboats from 145 to 175 feet long and from 28 to 30 feet wide used the canal, carrying from 550 to 1,200 bales of cotton.

The United States purchased the canal in December, 1902, at a cost of \$30,000. The canal when acquired by the United States was badly obstructed with snags, drift, and silt.

Amount expended on the canal up to the close of fiscal year ending June 30, 1907, \$67,308.86, of which \$30,000 was for purchase of canal and \$3,203.97 applied to maintenance.

The canal has been dredged for practically its entire length to a depth of 3 feet at mean low water and width of from 35 to 40 feet. The bank has been reenforced at various points by brush.

The length of the canal, from west end of Oyster Bay to Brazos River, is 29½ miles; ruling depth, 3 feet.

Variation of water surface is about 1 foot in the canal, except at the time of Brazos River overflow and northers.

This canal forms part of the inland waterway, and an appropriation has been made for it under that head. Some work has been done under the latter appropriation. (See p. 443 and Appendix U 9.)

Hereafter this work will be reported under the head of "Inland waterway on the coast of Texas."

As reported by the watchman at the Galveston and Brazos Canal, 352 vessels engaged in carrying freight passed up and down through the canal during the calendar year 1906, transporting 30 sacks oats, 387 barrels oysters, 108 tons merchandise, 365 piles, 205,000 feet lumber, 18 carloads furniture, 10 barrels honey, 205 cords brush, 500 pounds fish, 14 cords wood, 128 tons cotton, 7 tons cotton seed, and 50,000 shingles.

July 1, 1906, balance unexpended.....	\$7, 609. 56
Refundment of overpayment.....	1. 20

7, 610. 76

June 30, 1907, amount expended during fiscal year:

For works of improvement.....	\$4, 406. 79
For maintenance of improvement.....	3, 203. 97

7, 610. 76

(See Appendix U 7.)

8. *Operating and care of Galveston and Brazos Canal, Texas.*—A watchman was stationed at the canal during the year for operating the drawbridge over the canal and tending the log boom at mouth of canal.

The construction of a new drawbridge over the canal has been commenced. Materials were procured and the foundations partly completed.

An agreement has been made with the officials of Brazoria County by which they bind themselves to accept and maintain and care for the bridge upon completion.

A statement contained in the report of the local engineer officer shows the items of expenditure, which amounted to \$599.53, exclusive of liabilities outstanding, amounting to \$1,127.33.

(See Appendix U 8.)

9. *Inland waterway on the coast of Texas.*—The river and harbor act of March 2, 1907, appropriated \$133,829, and authorized the Secretary of War to enter into contract for materials and work to the extent of \$300,000, which is yet to be appropriated.

This project embraces the improvement of the following localities: West Galveston Bay and Brazos River Canal; channel from Aransas Pass to Pass Cavallo, including the Guadalupe River to Victoria; Turtle Cove channel from Aransas Pass to Corpus Christi, Tex.

The object of the improvement is to obtain and maintain a navigable channel depth of 5 feet in a canal along the coast of Texas, utilizing the lagoons lying between the islands and the mainland. The improvement will develop a light-draft inland navigation which will afford cheap transportation by light-draft steamers and barges to the coast country of Texas.

More and large boats with auxiliary gas engines have been built to utilize the improvement. Most of the points to be reached are settlements which railways can not afford to develop, but the improvements are of great importance to their commercial life.

It is proposed to apply the balance available and amount estimated as a profitable expenditure in dredging, snagging, etc., in accordance with approved project.

(a) *West Galveston Bay and Brazos River Canal.*—See page 442 and Appendixes U 7 and U 9.

The existing project was adopted by the river and harbor act of March 2, 1907, and provides for deepening the canal to 5 feet at an estimated cost of \$151,529, and \$20,000 annually for maintenance.

Amount expended on existing project to close of fiscal year ending June 30, 1907, \$843.45.

For report of examination, see House Document No. 640, Fifty-ninth Congress, second session.

Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	\$45,000.00
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	843.45

July 1, 1907, balance unexpended.....	44,156.55
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Amount (estimated) required for completion of existing project....	106,529.00
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{	Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907.....	106,529.00
	Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

(b) *Channel from Aransas Pass to Pass Cavallo.*—This channel was originally developed by the State of Texas and private parties and was the old United States mail route between Indianola and Corpus Christi. In 1875 vessels drawing not over 3 feet could navigate the channel, and in 1905  $2\frac{1}{2}$  feet was the ruling depth.

Variation of water surface, about three-quarters of a foot.

The channel to be developed extends from entrance to Turtle Cove, at Aransas Pass, to Matagorda Bay, at head of Pass Cavallo, a distance of about 63 miles.

The project contemplates a depth of 5 feet, at a cost of \$65,850.

Amount expended on existing project to close of fiscal year ending June 30, 1907, \$76.21.

Report of examination is printed in House Document No. 640, Fifty-ninth Congress, second session.

Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	\$40,000.00
June 30, 1907, amount expended during fiscal year, for works of improvement.....	76.21

July 1, 1907, balance unexpended.....	39,923.79
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July 1, 1907, outstanding liabilities.....	5.34
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July 1, 1907, balance available.....	39,918.45
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Amount (estimated) required for completion of existing project....	25,850.00
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{	Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907.....	25,850.00
	Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

(c) *Guadalupe River.—Bay section.*—This channel connects the mouth of the Guadalupe River with the channel from Aransas Pass to Pass Cavallo. For the first 8 miles there is 6 feet of water, shoaling to 4 feet at the twelfth mile, then through a flat with about 2 feet to the mouth of the river at the sixteenth mile.

Variation of water surface, about three-quarters of a foot.

The project contemplates a navigable waterway 5 feet deep and 40 feet wide at a cost of \$30,000.

*River section to Victoria, Tex.*—The Guadalupe River empties into San Antonio Bay 16 miles from the inland waterway on the coast of Texas. Its width varies from 90 feet at main entrance at mouth, increasing to 140 feet 52 miles above its mouth. The depth

varies from less than 3 feet over shoals to 20 feet at bends. Thick overhanging trees, numerous snags and sunken logs, together with rafts of recent formation, are found in the lower river. The river was formerly navigated to Victoria, 52 miles from its mouth, but owing to rafts navigation has been abandoned in recent years.

The project contemplates the removal of rafts, snags, etc., and the dredging of shoals to 5 feet, at a cost of \$62,700.

Amount expended on existing project to close of fiscal year ending June 30, 1907, \$38.76.

Report of examination is printed in House Document No. 336, Fifty-ninth Congress, second session.

Amount allotted from appropriation by river and harbor act approved March 2, 1907-----	\$38, 829. 00
Sales of contact prints-----	. 55

38, 829. 55

June 30, 1907, amount expended during fiscal year, for works of improvement -----	38. 76
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July 1, 1907, balance unexpended-----	38, 790. 79
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Amount (estimated) required for completion of existing project----	53, 871. 00
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{	Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907-----	53, 871. 00
	Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

(d) *Turtle Cove channel between Aransas Pass and Corpus Christi*.—This is a natural depression between Harbor and Mustang islands, connecting at high tide the waters of Aransas and Corpus Christi bays. It is about 13,500 feet long and 2,000 feet wide, with approximate depth of  $1\frac{1}{2}$  feet below mean low tide.

Variation of water surface, about 1 foot.

The project contemplates a channel  $8\frac{1}{2}$  feet deep at low tide and 75 feet wide at the bottom, at a cost of \$123,750.

Amount expended on existing project to close of fiscal year ending June 30, 1907, \$41.71.

For report of survey see House Document No. 338, Fifty-ninth Congress, second session.

Amount allotted from appropriation by river and harbor act approved March 2, 1907-----	\$10, 000. 00
June 30, 1907, amount expended during fiscal year, for works of improvement -----	41. 71

July 1, 1907, balance unexpended-----	9, 958. 29
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Amount (estimated) required for completion of existing project----	113, 750. 00
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{	Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907-----	113, 750. 00
	Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

## CONSOLIDATED.

Amount appropriated by river and harbor act approved March 2, 1907—\$133, 829. 00  
 Received from sales----- . 55

133, 829. 55

June 30, 1907, amount expended during fiscal year, for works of improvement ----- 1, 000. 13

July 1, 1907, balance unexpended----- 132, 829. 42

July 1, 1907, outstanding liabilities----- 5. 34

July 1, 1907, balance available----- 132, 824. 08

Amount (estimated) required for completion of existing project---- 300, 000. 00

{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907----- 300, 000. 00  
 Submitted in compliance with requirements of sundry civil act of June 4, 1897.

(See Appendix U 9.)

10. *Mouth of the Brazos River, Texas.*—The mouth of the river was originally obstructed by a bar, the crest of which was about three-eighths of a mile from the shore line, and the channel across afforded a variable depth of water for navigation of not over 8 feet at times (in October, 1874, only 2½ to 3 feet), being subject to changes due to winds, tides, and stages of water.

The original project was adopted in 1880 for the improvement of the channel over the bar by the use of jetties. The work was suspended in 1889. The amount expended on original project prior to operations under existing project was \$142,098.43.

After suspension of work by the United States the improvement of the mouth of this river was undertaken by the Brazos River Channel and Dock Company, which constructed two parallel jetties 560 feet apart. The northeast jetty was 4,708 feet long and the southwest 5,018 feet. In 1899 this company complied with the conditions of an act of Congress requiring a transfer to the United States of the jetties and auxiliary works; also a release of all rights and privileges conferred upon said company by its charter or by the act of Congress approved August 9, 1888, to charge or collect tolls for the use and navigation of said river. From the transfer of the works until the adoption of the present project the United States spent \$88,524.13.

The existing project (act June 13, 1902) is to repair and strengthen the jetties, construct spur dikes and bank protection, and to dredge a channel 18 feet deep and 150 feet wide. The estimated cost, \$250,000, was increased by \$175,000 after the hurricane of September 8, 1900. The act approved March 2, 1907, appropriated \$35,000 for continuing improvement and for maintenance.

Repairs to the jetties were continued during the year under continuing contract and protection to the banks by hired labor.

Amount expended on the work of existing project up to close of fiscal year ending June 30, 1907, \$175,352.57.

It is proposed to apply the balance available to completing the repairs of the jetties and dredging.

The Brazos River Channel and Dock Company's map shows that in March, 1889, there was a channel depth of 6 feet before the work

began, and later, in March, 1896, there was 20 feet. The company measured their depth from a plane of "average flood tide," or mean high water, 1.3 feet above the United States standard of mean low water. The channel width is about 440 feet.

The latest information shows a minimum depth on the bar of 13 feet at mean low water.

*Depth over the bar and below jetties at different dates.*

March, 1889, before the jetties were begun, as reported in Mr. Wisner's paper, page 532-----	mean low tide--	Feet. 4.7
December, 1891, as shown by United States Coast Survey chart-----	do-----	14.5
March, 1896, after completion of the jetties, as shown by survey of the Brazos River Channel and Dock Company-----	mean low tide--	19.0
January, 1897, as shown by the survey made for the Board by Mr. H. L. Marindin, United States Coast and Geodetic Survey-----	mean low tide--	14.8
February 28, 1905, life-saving inspector, Velasco, Tex-----	do-----	12.7
June, 1905, Charles Clarke & Co., approximately-----	do-----	12.0
June 30, 1906-----	do-----	14.0
May, 1907-----	do-----	13.0

Mean range of tide, 1.77 feet.

There was very little commerce using this improvement during the year.

So far this improvement has had very little effect on freight rates.

The project is about three-fourths completed.

July 1, 1906, balance unexpended-----	\$114,566.31
Amount appropriated by river and harbor act approved March 2, 1907-----	35,000.00
	<hr/> 149,566.31
June 30, 1907, amount expended during fiscal year, for works of improvement-----	89,282.78
	<hr/> 60,283.53
July 1, 1907, balance unexpended-----	60,283.53
July 1, 1907, outstanding liabilities-----	95.58
	<hr/> 60,187.95
July 1, 1907, balance available-----	60,187.95
Amount (estimated) required for completion of existing project----	102,500.00
(See Appendix U 10.)	

11. *Aransas Pass, Texas.*—Aransas Pass is on the south coast of Texas, 175 miles southwest of Galveston and 125 miles north of the Rio Grande, and is the outlet of Aransas Bay to the Gulf of Mexico. The area of the bay is about 80 square miles. It is connected with Corpus Christi Bay on one side and with Mesquite, St. Charles, and Copano bays on the other.

The depth over Aransas bar has varied greatly—from 9 feet in 1852, 9½ feet in 1871, 7 feet in 1875, to 8½ feet in 1887.

For projects and work done by the United States Government and private corporations at Aransas Pass, see Annual Report of the Chief of Engineers for 1898, page 1527 et seq.

Amount expended on original and modified project prior to operations under existing project, \$540,477.65, exclusive of \$9,938.93 subscribed by the citizens of Rockport and Corpus Christi, Tex.

Under the provisions of the river and harbor act of March 3, 1899, the Aransas Pass Harbor Company, under date of March 27, 1899, released and surrendered all rights and privileges theretofore granted

to it in Aransas Pass Harbor by Congress; also the jetties constructed in said harbor.

The river and harbor act of June 13, 1902, appropriated \$250,000, and provided that the work at this harbor should be confined to the completion of the north jetty in accordance with the design and specifications of the Aransas Pass Harbor Company and in continuation of the work theretofore carried out on said jetty by said company, and to such additional work as may be necessary for strengthening such jetty and for the removal of such part of the old Government jetty and any other hard material which may interfere with the formation of a channel by the natural action of the currents, and the act of March 3, 1905, appropriated \$100,000 and authorized an additional expenditure of \$100,000 for continuing the improvement, with the proviso that the amounts therein appropriated and authorized should be applied to the completion of the project in accordance with the design and specifications of the Aransas Pass Harbor Company, and in continuation of the work theretofore done, and to such additional work as might be necessary for strengthening the jetty.

Work was completed in accordance with the above project on June 11, 1906.

Prior to the adoption by Congress of the plans of the Aransas Pass Harbor Company the last appropriation had been expended in accordance with the project prepared by Maj. O. H. Ernst, Corps of Engineers, in 1887 (printed on pp. 1313 to 1315 of the Annual Report of the Chief of Engineers for 1888). This project called for two parallel jetties and the revetment of Mustang Island.

During the past fiscal year a rock lump with 16.5 feet of water over it, supposed to be the remains of the old Government jetty, was removed to a depth of more than 25 feet.

The amount expended on the work of existing project up to the close of the fiscal year ending June 30, 1907, was \$547,448.79.

The project was modified by the river and harbor act of March 2, 1907, to provide for improvement in accordance with plans submitted by the Board of Engineers for Rivers and Harbors in its report of December 22, 1906, printed in River and Harbor Committee Document No. 5, Fifty-ninth Congress, second session. This project provides, in the main, for a south jetty parallel to the general direction of the existing jetty, and the extension shoreward of the Haupt jetty to connect with St. Josephs Island, and later the extension of both jetties. The estimated cost of the work, including \$100,000 for a dredge, is \$1,288,699.50. Continuing contracts to the amount of \$290,000, yet to be appropriated, were authorized for prosecuting the work.

The minimum depth in the thalweg at the time of the last survey was 16.3 feet. The width of 15-foot channel was 100 feet. The local pilot states that under most favorable conditions of flood tide, extra smooth bay, etc., steam vessels of 13-foot draft and sailing vessels, not under tow, of 11-foot draft can be carried in.

The usual range of tide is 1.1 feet across the bar.

The only commercial statistics that could be obtained were partial records from Corpus Christi, as follows: One thousand two hundred tons of general merchandise, 273,291 feet of lumber (weighing approximately 819,873 pounds), 1,500 bales of cotton, and 50,000 pounds of wool carried through Aransas Pass channel since July 1, 1906.

The work done is not believed to have had any effect on freight rates as yet.

July 1, 1906, balance unexpended.....	\$114, 307. 11
Amount appropriated by river and harbor act approved March 2, 1907 .....	200, 000. 00
Proceeds of sales of contact prints.....	1. 65
	<hr/>
June 30, 1907, amount expended during fiscal year, for works of improvement .....	314, 308. 76
	<hr/>
July 1, 1907, balance unexpended.....	110, 983. 55
July 1, 1907, outstanding liabilities.....	203, 325. 21
	<hr/>
July 1, 1907, balance available.....	245. 99
	<hr/>
July 1, 1907, balance available.....	203, 079. 22
	<hr/>
Amount (estimated) required for completion of existing project.....	1, 088, 699. 50
	<hr/>
{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907.....	290, 000. 00
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

(See Appendix U 11.)

12. *Harbor at Brazos Santiago, Tex.*—The navigable depth over the bar before the improvement started was usually from 6 to 8 feet at mean low water.

The project for the improvement of this harbor, adopted in 1881, contemplated the construction of two jetties extending out into the Gulf of Mexico about 1,500 feet apart, one, the south or Brazos Island jetty, to be 3,630 feet long, and the other, the north or Padre Island jetty, to be 2,940 feet long. Work was suspended on this improvement in October, 1884, and the subject of the new improvement was reported on by The Board of Engineers. The cost of an improvement, to consist of two parallel jetties placed about 1,100 feet apart, was estimated at \$1,130,000. Adding previous expenditures of \$188,590.23 to this estimate makes the revised cost of the improvement \$1,318,590.23. No permanent increased depth was obtained over the bar.

The amount expended on this improvement to June 30, 1907, was \$241,913.81.

During the fiscal year 1905 a channel 70 feet wide on the bottom, with a least depth of 10 feet, was excavated from deep water inside the bar in a straight line across the Laguna Madre to the railroad wharf at Isabel, Tex., a distance of 12,000 feet; also a turning basin 400 feet long by 300 feet wide and 10 feet deep.

Prior to dredging this channel and turning basin there was a natural channel permitting boats drawing  $5\frac{1}{2}$  to 6 feet to navigate across the Laguna Madre from the bar to the railroad wharf at Isabel, Tex., at high tide. With the channel and turning basin completed, light-draft steamers and sailing vessels that could get over the bar could proceed direct to the railroad wharf at Isabel, Tex., and unload, in place of being lightered off Brazos Island. During the year this channel has shoaled in places to less than 6 feet at mean low tide. The tidal range is from  $1\frac{1}{2}$  to 2 feet.

The latest information gives 8 feet as the minimum depth on bar.

No commercial statistics have been obtained.



It is proposed to expend the balance available in redredging the channel and turning basin.

July 1, 1906, balance unexpended.....	\$5,672. 70
June 30, 1907, amount expended during fiscal year, for works of improvement.....	86. 51

July 1, 1907, balance unexpended.....	5,586. 19
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(See Appendix U 12.)

13. *Construction of sea wall, embankment, and fill along the front of Fort Crockett Reservation, Galveston, Tex., and constructing sea wall from Thirty-ninth street to the west line of Forty-fifth street, in the city of Galveston.*—The sundry civil act approved April 28, 1904, contained an item for the protection of the sea front of the Fort Crockett Reservation, and appropriated \$181,046.25 for the purpose.

By sundry civil act approved June 30, 1906, an additional amount of \$158,953.75 was appropriated for completing the work.

Construction of the sea wall and riprap embankment along the western boundary of the reservation was completed October 18, 1905.

The work of filling and sodding the reservation and behind the sea wall between Thirty-ninth and Forty-fifth streets was carried on during the year and on June 30, 1907, was 70 per cent completed.

The amount expended on existing project to June 30, 1907, was \$466,644.10.

It is proposed to use the balance available in completing the project.

July 1, 1906, balance unexpended.....	\$426,638. 53
Refundment on overpayment.....	. 09

426,638. 62

June 30, 1907, amount expended during fiscal year, for works of improvement.....	143,282. 63
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July 1, 1907, balance unexpended.....	283,355. 99
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July 1, 1907, outstanding liabilities.....	42,497. 60
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July 1, 1907, balance available.....	240,858. 39
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July 1, 1907, amount covered by uncompleted contracts.....	169,426. 67
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(See Appendix U 13.)

14. *Removing sunken vessels or craft obstructing or endangering navigation.*—The hurricane of September 8, 1900, strewed the waters of Galveston Bay with wrecks of boats, beacons, and bridges, and same have become a menace to navigation. Most of these wrecks have been removed.

An allotment of \$500 was made for the expense of removing a sunken barge off the mouth of Clear Creek.

No work has been performed except for investigation.

The expenditures, which amounted to \$39.27, were for investigating wrecks.

## EXAMINATIONS AND SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT APPROVED MARCH 3, 1905.

Reports on preliminary examinations and surveys required by the river and harbor act approved March 3, 1905, of the following localities within this district were duly submitted by the district officer. They were reviewed by the Board of Engineers for Rivers and Harbors, pursuant to law, and were transmitted to Congress and printed in documents as indicated:

1. *Survey of channel from Aransas Pass to and up Guadalupe River to Victoria, and from Victoria to Cuero, Tex.*—Report, dated June 14, 1906, is printed in House Document No. 336, Fifty-ninth Congress, second session. Several plans with estimate and cost of improvement are presented, but only one, that for improvement from Aransas Pass to Matagorda Bay, at an estimated cost of \$73,800, with \$10,000 annually for maintenance after completion, is deemed worthy of being undertaken by the United States.

2. *Survey for channel from Aransas Pass, via Turtle Cove, to Corpus Christi, Tex.*—Report, dated May 22, 1906, is printed in House Document No. 338, Fifty-ninth Congress, second session. A plan is presented for improvement, at an estimated cost of \$123,750.

3. *Preliminary examination of Galveston Harbor, Texas, with a view to obtaining a uniform depth of 30 feet.*—Report, dated July 13, 1906, is printed in House Document No. 340, Fifty-ninth Congress, second session. An estimate of \$600,000, which will provide for the construction of a dredge and its operation for a year and for the operation of the dredge *Comstock* for two years, is submitted, this amount being in addition to the sum required to complete the repairs to the existing jetties already authorized by Congress.

4. *Preliminary examination of Galveston channel, Galveston Harbor, Texas, with a view to its enlargement and extension farther west.*—Report, dated February 13, 1907, is printed in House Document No. 768, Fifty-ninth Congress, second session. A plan is presented for enlarging the existing project by extending the projected channel from Fifty-first street to Fifty-seventh street, with a width of 700 feet, at an estimated cost of \$129,310.

5. *Preliminary examination with plan and estimate of cost of improvement of inland waterway from the Rio Grande River, Texas, to the Mississippi River at Donaldsonville, La.*—Report, dated December 14, 1906, is printed in House Document No. 640, Fifty-ninth Congress, second session. Several estimates of cost are submitted, the plans for improvement which are considered advisable being as follows:

Aransas Pass to Pass Cavallo—estimated cost \$65,850, with \$10,000 annually for maintenance.

Brazos River to Galveston—estimated cost \$141,528.80, and \$20,000 annually for maintenance.

Mermentau River to Mississippi River through Bayou Plaquemine—estimated cost \$289,292, and \$20,000 annually for maintenance.

IMPROVEMENT OF BRAZOS RIVER FROM VELASCO TO WACO AND OF TRINITY RIVER, TEXAS; OF CYPRESS BAYOU, LOUISIANA AND TEXAS; OF RED RIVER ABOVE FULTON, ARKANSAS, AND SULPHUR RIVER, ARKANSAS AND TEXAS.

This district was in the charge of Capt. W. P. Wooten, Corps of Engineers. Division engineer, Lieut. Col. Clinton B. Sears, Corps of Engineers, until July 16, 1906, and Col. Ernest H. Ruffner, Corps of Engineers, since that date.

*1. Brazos River, Texas, from Old Washington to Waco.*—[This work was in the charge of Maj. Edgar Jadwin, Corps of Engineers, to April 9, 1907.] This section of the river was ordinarily not originally navigable above Hidalgo Falls. From there to Waco the profile of the river is an alternating series of steep and gentle slopes, rendering it susceptible of effective improvement by a combination of locks and dams with open-channel work between.

In the river and harbor act of March 3, 1905, an examination of this section was ordered and a provisional appropriation for its improvement was made. In the act of March 2, 1907, a further appropriation was made, in accordance with a project submitted in a report published in House Document No. 705, Fifty-ninth Congress, first session. This project contemplates securing a navigable depth of 4 feet for four months and  $3\frac{1}{2}$  feet for six months of the year by constructing eight locks and dams and 103 miles of open-channel work, at a total cost of \$2,915,000. It is not clear to what extent the project outlined therein may be regarded as adopted by Congress in appropriating for the work, and in the money statement given below it is assumed that the Government is committed to the construction of only one lock and dam at an estimated cost of \$300,000.

The river and harbor act of March 2, 1907, authorized continuing contracts in the sum of \$150,000, yet to be appropriated, for completion of lock and dam at Hidalgo Falls.

On June 30, 1907, \$87,748.69 had been expended on this project in the construction of a lock and dam at Hidalgo Falls.

As the work on this section has just begun, no results in the way of increased depths have yet been obtained, and no commerce has had an opportunity to develop.

Taken in connection with the improvement of the lower section of the river, when its navigable capacity is fully developed it should have a very pronounced effect, not only on freight rates in the section which it traverses, but also on rates from more distant points, as the freights carried on roads traversing its valley are heavy and the rates high.

The available balance will be applied to the continuance of the construction of Lock and Dam No. 1 at Hidalgo Falls. The additional appropriation requested will be applied to completing this work.

Reports of examinations and surveys are published in the Annual Reports of the Chief of Engineers as follows: 1875, page 929; 1895, page 1833; 1901, page 2009, and in House Document No. 705, Fifty-ninth Congress, first session.

July 1, 1906, balance unexpended.....	\$54,253.53
Amount appropriated by river and harbor act approved March 2, 1907.....	75,000.00
Amount refunded account disallowance on voucher.....	2.17
	<hr/>
June 30, 1907, amount expended during fiscal year, for works of improvement.....	129,255.70
	<hr/>
July 1, 1907, balance unexpended.....	62,251.31
July 1, 1907, outstanding liabilities.....	10,790.72
	<hr/>
July 1, 1907, balance available.....	51,460.59
Amount (estimated) required for completion of existing project.....	<sup>a</sup> 150,000.00
	<hr/>
{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907.....	
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897.....	
{	

(See Appendix V 1.)

2. *Brazos River, Texas, from Velasco to Old Washington.*—[This work was in the charge of Maj. Edgar Jadwin, Corps of Engineers, to April 9, 1907.] This section of the river has a width of from 200 to 400 feet. It has good depth from the mouth to near the head of tidewater above Columbia (mile 36). It is navigable for light-draft boats throughout its length for about eight months in the year.

The original project for this improvement was adopted June 3, 1896, and contemplated the removal of snags and overhanging trees and dredging troublesome shoals between Velasco and Richmond only. The sum of \$5,000 was expended on this project.

In the river and harbor act of June 13, 1902, the improvement from Richmond to Old Washington was undertaken. In the act of March 3, 1905, this improvement was continued from Velasco to Old Washington. The project on which these appropriations were based (see Report of the Chief of Engineers, 1901, p. 1974) contemplated the improvement of the river by open-channel work between the mouth and Old Washington, at a cost of \$225,000.

Amount expended on work of existing project up to June 30, 1907, was \$177,545.48.

A depth of 4 feet for approximately eight months in the year has been obtained.

Complete statistics as to commerce have not been obtainable, but the leading articles hauled are sugar, molasses, oil, wood, and provisions. The freight handled can not be a maximum, and a reduction in rates can not be effected until the section of the river between Old Washington and Waco is made navigable.

It is proposed to apply the available balance to continuing and maintaining the improvement.

For reports of examinations and surveys see Annual Reports of the Chief of Engineers as follows: 1893, page 1893; 1895, page 1838; 1901, page 1974.

<sup>a</sup> For lock and dam at Hidalgo Falls only.

July 1, 1906, balance unexpended.....	<sup>a</sup> \$8,435.92
Amount appropriated by river and harbor act approved March 2, 1907..	75,000.00
Amount received account of sales of condemned property and refund- ment.....	66.42
	<hr/> 83,502.34
June 30, 1907, amount expended during fiscal year, for works of im- provement.....	11,047.82
	<hr/>
July 1, 1907, balance unexpended.....	72,454.52
July 1, 1907, outstanding liabilities.....	1,143.25
	<hr/>
July 1, 1907, balance available.....	71,311.27
(See Appendix V 2.)	

3. *Trinity River, Texas.*—The river in its upper reaches is a narrow stream with a low-water depth insufficient for even light-draft navigation. Its banks are generally high and quite stable, making it particularly susceptible to improvement by canalization.

The river and harbor act of June 13, 1902, adopted a project for the improvement of this stream in accordance with a report submitted in House Document No. 409, Fifty-sixth Congress, first session. (See Annual Report of the Chief of Engineers for 1900, p. 2348.) This project contemplated improvement to provide a 6-foot navigation from Dallas to the mouth, a distance of 511 miles, by open-channel work and a system of locks and dams.

The original estimate of cost of this improvement was \$4,550,000. The portion of this applicable to section 1 (\$350,000) was afterwards raised to \$918,000 in a report from a Board of Engineers appointed to examine into the cost. (See Annual Report of the Chief of Engineers for 1904, p. 2021.)

The amount expended on this improvement up to June 30, 1907, was \$222,393.02, the greater part of which has been applied to cleaning the river of obstructions.

Four locks and dams in section 1 have already been provided for by Congress. The money for Nos. 1, 2, and 6 has already been appropriated, and funds have been appropriated and pledged for No. 4 and for a lock and dam at Hurricane shoals, which is in section 2 and is estimated to cost \$160,000. An authorization of \$300,000 for these locks is still to be appropriated.

The expenditures made in cleaning the river have resulted in no increased depth, but the removal of snags and drifts has made the stream safer to navigate at medium and high stages. There is no navigation of account above Liberty other than the rafting of logs.

Owing to the fact that the river is not yet navigable to Dallas, the only place at which it can come into active competition with the railroads, no effect on freight rates has been produced. Inasmuch as the leading trunk lines of this section are crossed by the river at Dallas, there can be no doubt that when the river is made navigable to this point it will result in a considerable reduction and an immense saving, not only in local, but also in interstate freight rates in this section.

It is proposed to apply the available balance and the additional appropriation asked for to the completion of locks and dams already authorized, and to further improvements in the prosecution of the existing project.

<sup>a</sup> Erroneously given in last year's report as \$8,435.72.

For references to reports of examinations and surveys see Annual Report of the Chief of Engineers for 1906, page 431.

July 1, 1906, balance unexpended.....	\$417, 276. 76
Amount appropriated by sundry civil act approved March 4, 1907....	75, 287. 00
Amount appropriated by river and harbor act approved March 2, 1907..	75, 000. 00
	<hr/> 567, 563. 76
June 30, 1907, amount expended during fiscal year, for works of improvement.....	80, 638. 51
July 1, 1907, balance unexpended.....	486, 925. 25
July 1, 1907, outstanding liabilities.....	2, 589. 51
	<hr/> 484, 335. 74
July 1, 1907, amount covered by uncompleted contracts.....	240, 664. 65
Amount (estimated) required for completion of existing project.....	<hr/> 2300, 000. 00

{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907.....<sup>a</sup>150, 000. 00  
 { Submitted in compliance with requirements of sundry civil act of June 4, 1897.

(See Appendix V 3.)

4. *Cypress Bayou, Texas and Louisiana.*—During the period of the great raft in Red River the bottom lands of Cypress Bayou were flooded—became lakes—and afforded a navigable route from Red River near Shreveport, La., to Jefferson, Tex., 65 miles. Work by the United States for the improvement of this route commenced in 1872, and from 1872 to 1879 \$94,000 was appropriated for the purpose. The funds were expended for dredging and straightening the channel, removing stumps, snags, and logs, and cutting leaning timber. This work was completed in 1880, but on account of its temporary nature appropriations and allotments aggregating \$39,701.33 were made for maintenance.

The removal of the raft and the subsequent closure of outlets and construction of levees down the right bank of Red River from the hills in Arkansas to near Shreveport, La., cut off the water supply of the lakes, which, in conjunction with the quicker drainage resulting from the lowering of the bed of Red River, gradually caused them to dry up. In consequence the period of navigation shortened from year to year until 1897, when boats from Red River ceased plying altogether. A survey to ascertain if improvement could be obtained by locks and dams was completed in 1893, but the plan proposed was not adopted by Congress.

The amount expended to June 30, 1907, was \$134,690.61 for improvement and maintenance and \$12,613.05 for surveys. The work of maintenance so merges into the work of improvement that it is difficult to state just what portion of the expenditures was for maintenance and what for improvement.

The water supply of the drainage basin of the lakes has been reduced so greatly and the channel of Red River above Shreveport has lowered so much that steamboats now can cross Albany flats, at foot of the lake only at rare intervals during exceptionally high stages of Red River or after heavy rains in the drainage basin of the lakes.

<sup>a</sup> Includes only such work as Congress has specifically authorized.

The work of removing obstructions now in progress has rendered navigation safer between Jefferson and Mooringsport and has consequently caused some increase in the quantity of such local navigation. This navigation by giving access to a competing railroad has resulted in keeping freight rates somewhat below those existing in neighboring sections.

It is proposed to apply the available balance to removing obstructions from the channel and marking channel through the lakes.

For references to reports of examinations and surveys see Annual Report of the Chief of Engineers for 1906, page 432.

July 1, 1906, balance unexpended.....	\$2, 589. 61
Amount appropriated by river and harbor act approved March 2, 1907.....	10, 000. 00
	<hr/>
	12, 589. 61
June 30, 1907, amount expended during fiscal year, for works of improvement.....	4, 191. 94
	<hr/>
July 1, 1907, balance unexpended.....	8, 397. 67
July 1, 1907, outstanding liabilities.....	172. 40
	<hr/>
July 1, 1907, balance available.....	8, 225. 27

(See Appendix V 4.)

5. *Red River between Fulton, Ark., and Denison, Tex.*—This part of the river was originally navigable for small boats during high stages only. The river at low water is a stream from 100 to 200 feet wide in the bends, winding in a shifting channel between banks which are frequently several hundred yards apart. The low-water depth varies from 1.5 to about 4 feet. The banks are covered with trees constantly caving into the river and forming snags and drifts.

The original appropriation for work above Fulton was made August 5, 1886. The project contemplated improving only high and medium-stage navigation by removing snags and drift. Previous to the existing project no work was provided for above the mouth of the Kiamichi River. The amount expended under previous projects is \$33,500.

The river and harbor act of March 3, 1905, entered upon a project for the improvement of the river between Fulton, Ark., and Denison, Tex. The project contemplates the removal of drift and snags, clearing the banks of timber in danger of caving into the river, and closing chutes and cut-offs where necessary. No estimate of cost has been made.

At the close of the fiscal year \$67,556.09 had been expended on this project.

The work done under this project has not brought out any material increase of depth or width, but has resulted in the removal of a number of snags and other obstructions, and has rendered navigation less dangerous. At mean low water the river is not navigable in its shoalest parts by boats drawing more than 1.5 feet. The usual variation between high and low water is about 30 feet. During medium and high stages this section of the river is navigable throughout its whole length of 292 miles.

Beyond the rafting of logs and timber there has been no commerce of any value on this section of the river.

When this section of Red River is opened to regular navigation a very material reduction in both local and through freight rates to points in north Texas and Oklahoma must necessarily result.

To secure a stable improvement will require a continuance of work for a number of years. The available balance will be applied to continuing the work now under way of removing obstructions and bank clearing.

For references to reports of examinations and surveys see Annual Report of the Chief of Engineers for 1906, page 433.

July 1, 1906, balance unexpended.....	\$48, 620. 63
Amount appropriated by river and harbor act approved March 2, 1907.....	100, 000. 00
	<hr/> 148, 620. 63
June 30, 1907, amount expended during fiscal year, for works of improvement.....	16, 176. 72
July 1, 1907, balance unexpended.....	132, 443. 91
July 1, 1907, outstanding liabilities.....	2, 058. 85
	<hr/> 130, 385. 06
July 1, 1907, balance available.....	
July 1, 1907, amount covered by uncompleted contracts.....	21, 840. 00

(See Appendix V 5.)

6. *Sulphur River, Texas and Arkansas.*—Sulphur River for about 150 miles from its mouth is from 150 to 200 feet wide, with navigable depths, except for a few shoals. The banks are, as a rule, firm and stable. The stream is, however, badly obstructed by snags and sunken logs.

In 1896 and 1897 the sum of \$2,488.99 was expended on snagging operations.

The existing project was adopted by the river and harbor act of March 2, 1907, and contemplates improvement of 150 miles of the river above the Red River by dredging and operation of a snag boat, at an estimated cost of \$36,000, assuming that a United States boat is available. No expenditures have been made under this project.

Owing to the poor navigable condition of the stream at present no commerce of any account has developed. As the stream drains a very rich section of the country it is expected that it will be extensively used when improved, and that some reduction in freight rates will result.

It is proposed to expend the available balance in clearing the river of obstructions and dredging where necessary.

Reports of examinations may be found in the Annual Reports of the Chief of Engineers, as follows: 1884, page 1345; 1893, page 2083; 1904, page 2084; and in House Document No. 870, Fifty-ninth Congress, first session.

Amount appropriated by river and harbor act approved March 2, 1907.....	\$36, 000. 00
July 1, 1907, balance unexpended.....	36, 000. 00

(See Appendix V 6.)



IMPROVEMENT OF RED RIVER BELOW FULTON, ARKANSAS, AND OF CERTAIN RIVERS AND WATERWAYS IN LOUISIANA, ARKANSAS, AND MISSISSIPPI TRIBUTARY TO MISSISSIPPI RIVER.

This district was in the charge of Capt. G. M. Hoffman, Corps of Engineers. Division engineer, Lieut. Col. Clinton B. Sears, Corps of Engineers, to July 16, 1906, and Col. E. H. Ruffner, Corps of Engineers, since that date.

1. *Red River below Fulton, Ark.*—This improvement was undertaken by the United States in 1828, and between 1828 and 1841 more than \$425,000 was appropriated for removal of the great Red River raft. When work commenced the raft was 92 miles long, extending from Loggy Bayou, 65 miles below Shreveport, La., to Hurricane Bluffs, 27 miles above. A channel was opened through this obstruction, but, owing to failure of appropriations between 1841 and 1852, additional raft formed. In 1852, \$100,000 was appropriated, and in 1857 the agent in charge reported the route opened but not completed, with recommendation for appropriations of \$50,000 a year for completion and maintenance. The total amount expended from 1828 to 1857 was \$532,219.90. Nothing further was done for fifteen years, and in that long interval the results of much of the former work were lost.

When work was resumed in 1872 the river above Shreveport, La., was closed by raft 32 miles long, which was growing constantly. Below Shreveport the enlargement of an outlet through Tones Bayou was depleting the main channel and threatening its closure to navigation. At Alexandria, La., the falls were impassable at low stages. Navigation was difficult and dangerous at all places and at all times. The channel shifted frequently, and at flood the river overflowed the entire raft region. Both above and below Shreveport the bed of the river was a mass of sunken logs and stumps. The banks were heavily timbered, and each flood caused them to cave or slide.

The project entered upon in 1872 contemplated opening navigation through the raft and closing Tones Bayou outlet. Under the river and harbor act of 1878 the removal of wrecks, snags, and other obstructions below Shreveport was commenced, and the act of 1879 authorized the same kind of work above the raft to Fulton, Ark. Work was carried on under three distinct appropriations until 1882, when it was combined in a general appropriation for continuing the improvement from Fulton, Ark., to the Atchafalaya River, Louisiana, with a provision for work at Alexandria, La. The river and harbor acts of 1884 and 1890 contained provisions for closing Sale and Murphy outlet, Louisiana; the acts of 1888, 1892, and 1894 authorized expenditures for improvement of Cypress Bayou, Bayou Dorcheat, and Sulphur River, tributaries of Red River; the act of 1902 provided for improvement of the channel at Shreveport, La., and the act of 1905 contained a provision for further improvement of the channel at Alexandria, La.

The existing project, adopted by Congress in the river and harbor act of July 13, 1892, contemplates the systematic clearing of the banks to remove the source of drift and snags; continuing snagging operations and the removal of jams and raft; dredging tow-heads and shoals; constructing a substantial system of levees to fix the course of the river, either alone or by cooperating with riparian

States; the closure of all outlets that deplete the river; the fixing of caving banks to confine the river to the selected channel, and the prevention of injuries to regimen by new cut-offs or outlets. The nature of the improvement requires that it be continued for many years, and no estimate for completion is given on this account.

The amount expended from 1872 to the close of the fiscal year ending June 30, 1907, including \$5,416.97 derived from sales and \$43.11 from refundments of overpayments, was \$1,710,481.60, with the following chief results: The channel cleared through the great raft in 1872-73 opened to navigation 188 miles of river above Shreveport to Fulton. Subsequent work secured the complete removal of the raft, prevented formations of the same nature, increased the width of the river 100 feet or more, and there now flows in the course laid out for it in the old raft region a broad and deep river, safe for navigation at all but the lowest stages. Fifteen years ago the survey showed that the low-water line at head of the raft had lowered more than 15 feet since 1872, and that this change continued downstream through the raft region and gradually diminished to about 3 feet at Shreveport. The continual progressive scour is attaining a normal slope in that stretch. Incidentally the removal of the raft drained the fertile valley and reclaimed thousands of acres of productive lands. Tones Bayou outlet is closed by a heavy earthen dam, connected with the line of levee above and below it, and the main channel, for a time called "Little River," has widened and scoured until navigation of the stretch is uninterrupted at low stages. All of the chief outlets along the right bank above Tones Bayou to the Arkansas-Louisiana line, 89 miles, have been closed with dams by cooperation with the State of Louisiana and local levee districts. Work at Alexandria Falls rendered them navigable at all stages. The channel was deepened from  $2\frac{1}{2}$  to  $5\frac{1}{2}$  feet at the lower falls and to 6 feet at the upper falls, lengthening the period of navigation about two months. Persistent snagging operations, repeated from year to year, have kept the river open and enabled steamboats to make regular trips, the river from the Atchafalaya to Fulton ordinarily being open for boats of 3-foot draft at stages about a foot above zero of the Shreveport gauge. The maximum draft that can be carried at mean low water is 3 feet to Montgomery, La., 162.5 miles above the Atchafalaya;  $2\frac{1}{2}$  feet to Shreveport, 320.5 miles, and 2 feet to Fulton, Ark., 508.6 miles. The range between low and high water at the several gauge stations is as follows: Fulton, Ark., 35.65 feet; Shreveport, La., 41.2 feet; Alexandria, La., 41.95 feet, and Barbre Landing, Louisiana (head of Atchafalaya River), 52.72 feet.

At present steamboats seldom run above Fulton, Ark., but at high stages the river is navigable in fact to Denison, Tex., 292 miles above Fulton and 800 miles above the Atchafalaya River.

During the fiscal year ending June 30, 1907, snagging operations, etc., for maintenance of the improvement extended over the river between the head of the Atchafalaya River, Louisiana, and Fulton, Ark. In the autumn of 1906 four permeable dikes were built along the right (caving) bank at Rattling Slough, Louisiana, about 135 miles below Fulton, for the protection of Red Bayou levee, built by the United States in 1895-96. In December, 1906, a reexamination at Alexandria, La., was made, and March 1, 1907, a plan was approved for repairing and strengthening the dikes at that locality, to reestab-

lish their full effect. Conditions were not favorable for this work to close of the fiscal year.

To maintain what has been accomplished and to gradually secure a more stable improvement will require a continuance of work for many years. The estimated cost is \$75,000 a year, or biennial appropriations of \$150,000, exclusive of extraordinary demands for new plant that will arise from time to time. The available funds will be applied to continuing the improvement and to maintenance and will be sufficient for two years' work.

Notwithstanding the facilities for quick transportation afforded by railways, the commerce of Red River consists of large shipments of cotton, cotton seed and its products, lumber, staves, timber, etc., with heavy return freights of general merchandise and plantation supplies.

The commerce and navigation reported for seventeen years show great variations, due to the changing crop conditions, occasional periods of extraordinary low water during the busy season, and other causes, ranging in quantity from 66,376 to 279,946 tons per annum, with estimated values of from \$1,506,500 to \$9,185,000. The average for the seventeen years is 123,889 tons, valued at \$4,505,791. To this should be added the commerce from Ouachita River, entering Red River at the mouth of Black River, the average of which is 178,429 tons, valued at \$6,105,200, making a total of 302,318 tons, valued at \$10,610,991.

The project has effected a reduction of freight rates on all commodities.

For more extended information respecting the work performed, reference is invited to the report and illustrations at page 1909 of the Report of the Chief of Engineers for 1893, and to the subsequent reports of the district officers. Maps of Tones Bayou, Bayou Pierre, etc., were published in the reports of 1882, page 1542, and 1885, page 1490. An index sketch of the basin of Red River and diagrams showing the limits of high and low water were published in the report of 1891, page 1956, and the report of 1892, page 1587. Maps of the river at Shreveport were published in the reports of 1887, page 2682, and 1893, page 1921. Map of the river at Alexandria was printed in House Document No. 462, Fifty-sixth Congress, first session.

References were given in the Annual Report of 1904 to reports of examinations and surveys, with page numbers at which they may be found. (See Report of the Chief of Engineers, 1904, pp. 385 and 386.)

July 1, 1906, balance unexpended.....	\$126,205. 47
Amount received from sales.....	147. 25
Amount appropriated by river and harbor act approved March 2, 1907 .....	150,000. 00
	276,352. 72
June 30, 1907, amount expended during fiscal year, for maintenance of improvement .....	31,374. 24
July 1, 1907, balance unexpended.....	244,978. 48
July 1, 1907, outstanding liabilities.....	2,481. 21
July 1, 1907, balance available.....	242,497. 27

(See Appendix W 1.)

2. *Ouachita and Black rivers, Arkansas and Louisiana.*—The improvement of Ouachita River by the United States commenced in 1871. At that time navigation was much obstructed at all stages by snags, sunken logs, wrecks, leaning and caving trees, etc., and the greater part of the river was unnavigable at low water on account of numerous rock, gravel, and sand bars.

The project of 1871 contemplated temporary improvement from Trinity, La., to Arkadelphia, Ark., by removal of snags, etc., and by dredging the worst bars. In 1872 a project was adopted for locks and dams to give 4 feet depth from Trinity, La., to Camden, Ark., but was abandoned two years later. The project under which work continued after 1874 contemplated the removal of snags, logs, wrecks, leaning timber, etc., obstructing navigation below Camden, Ark. The 56 miles known as Black River, below Trinity to Red River, Louisiana, was added to the project in 1884. The amount expended on the original and modified projects prior to operations under the existing project was \$605,947.19, including \$145 derived from refundments of overpayments.

The existing project, besides a continuation of snagging work, contemplates the construction of nine locks and movable dams to afford a navigable depth of 6½ feet from the mouth of Black River, Louisiana, upstream to a point 10 miles above Camden, Ark. (360 miles). The original estimate of cost, \$1,998,576, was increased to \$2,109,980 by river and harbor acts of March 3, 1905, and March 2, 1907. The project was adopted in part by a provision in the river and harbor acts of June 13, 1902, and March 3, 1905, authorizing continuing contracts (of which \$40,312 yet remains to be appropriated) for building Lock and Dam No. 4, near Monroe, La., and Lock and Dam No. 6, near Roland Raft, Ark., completing the survey for locks and dams, and maintenance of prior work. The river and harbor act of March 2, 1907, authorized continuing contracts in the sum of \$360,823, yet to be appropriated for the construction of Lock and Dam No. 2, near Catahoula shoals, Louisiana, and Lock and Dam No. 8, near Franklin shoals, Arkansas.

The amount expended under the existing project to June 30, 1907, was \$154,751.50 (including \$1,544.21 derived from sales and 35 cents from overpayments). Of this amount \$11,508.03 has been applied to completion of survey and \$64,658.41 to maintenance.

A contract for building Locks and Dams Nos. 4 and 6, let September 7, 1904, provided for their completion by December 31, 1906, but this time limit has been waived. Work commenced October 28, 1904, but abnormally high stages of the river limited the time of actual construction to twenty-four weeks' work during the fiscal years 1905, 1906, and 1907. Previous gauge records for fourteen years, from July, 1890, to July, 1904, showed the yearly average working stage (below 10 feet on the Monroe gauge) to be one hundred and sixty-four days. On June 30, 1907, the condition of the work was as follows: Lock and Dam No. 4 about 15 per cent completed; Lock and Dam No. 6 about 6½ per cent completed.

During the fiscal year ending June 30, 1907, snagging work for maintenance extended from Camden, Ark., to the mouth of Black River, Louisiana, with greatly beneficial results. A contract was

entered into April 2, 1906, for the construction of a new steel snag boat to replace the *O. G. Wagner*, purchased in 1875, worn out in service, and condemned and sold, and at close of the year this boat was about 50 per cent completed.

The additional appropriation asked for will be applied toward completing Locks and Dams Nos. 2, 4, 6, and 8.

The work heretofore done has consisted chiefly of the removal of snags, logs, wrecks, leaning timber, tree slides, etc., for the purpose of maintaining navigation and the improvement of Catahoula shoals, a rock and gravel bar about 20 miles above Trinity, La., where the available depth at low water was increased from 15 to 40 inches. At moderately high stages, or for six to seven months of the year, New Orleans steamboats ascend the river to Camden, Ark.; at medium stages they run to Monroe, La., but during the periods of low water Harrisonburg, La., 72 miles above Red River, is considered the head of navigation, though small local packets make trips between points on the river above. The maximum draft that can be carried at mean low water is  $3\frac{1}{2}$  feet to Harrisonburg, La.;  $1\frac{1}{4}$  feet to Monroe, La., and 8 inches to Camden, Ark. The range between high and low water at the several gauge stations on Ouachita River is as follows: Camden, Ark., 44.2 feet; Monroe, La., 48.6 feet; Riverton, La., 51.3 feet, and Jonesville, La., 54.1 feet. Camden, Ark., is considered the head of navigation, but at high stages the river is navigable in fact to Arkadelphia, Ark.

The commerce of Ouachita River and its tributaries is considerable and consists of shipments of cotton, cotton seed, lumber, staves, saw logs, and miscellaneous articles, with return freights of general merchandise and plantation supplies. Most of the cotton is shipped to New Orleans, and large quantities of staves for export are sent to that city. The volume of commerce, as reported for seventeen years, ranges between 73,679 and 313,863 tons per annum, with values estimated at \$3,243,200 to \$10,234,250. The average is 178,429 tons, valued at \$6,105,200. The variations are due to crop yields, the uncertainty of navigation, droughts, and other causes, and the improvement by locks and dams is for an extension of benefits by affording navigation to Camden the year round.

The project has effected a reduction of railroad rates from New Orleans to Monroe, La., and points below to meet the steamboat rates. The territory above Monroe was opened to railroad traffic a few years ago, but the lines as yet have not met the water rates. During periods of navigation the rate on cotton from Monroe to New Orleans is \$1.25 per bale, but when navigation is suspended this rate is advanced to \$1.75 per bale. Railroad rates from Monroe, La., to inland towns, as a rule, are greatly in excess of those to points where there is water competition.

For more extended information respecting this improvement, reference is invited to the report of 1895 (p. 1887) and to subsequent reports of the district officers.

An index to reports of examinations and surveys was published in the Report of the Chief of Engineers, 1904, page 389.

July 1, 1906, balance unexpended.....	\$446, 721. 80
Amount received from sales of property.....	4. 25
Amount appropriated by river and harbor act approved March 2, 1907.....	200, 780. 00
	<hr/> 647, 506. 05
June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$22, 930. 89
For constructing snag boat.....	15, 293. 88
For maintenance of improvement.....	9, 556. 41
	<hr/> 47, 781. 18
July 1, 1907, balance unexpended.....	599, 724. 87
July 1, 1907, outstanding liabilities.....	983. 50
	<hr/> 598, 741. 37
July 1, 1907, balance available.....	<hr/> 598, 741. 37
July 1, 1907, amount covered by uncompleted contracts.....	425, 236. 84
Amount (estimated) required for completion of existing project.....	<hr/> <sup>a</sup> 401, 135. 00

{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907.....<sup>b</sup>401, 135. 00  
 Submitted in compliance with requirements of sundry civil act of June 4, 1897.

(See Appendix W 2.)

3. *Bayou Bartholomew, Boeuf River, Tensas River and Bayou Maçon, and Bayous D'Arbonne and Corney, Louisiana and Arkansas.*—These streams are tributaries of Ouachita River and are not navigable at low stages. The works were consolidated by the river and harbor act of June 13, 1902. The improvements are all of the same character, i. e., the removal of snags, wrecks, leaning timber, etc., to lessen the danger and lengthen the period of navigation. Drift, sliding and caving banks, and the rapid growth of vegetation constantly add obstructions.

(a) *Bayou Bartholomew, Louisiana and Arkansas.*—Before improvement this stream was navigable for light boats about three months of the year. In 1880 an examination showed that passage-way for steamboats was much obstructed.

The project adopted March 3, 1881, contemplated removing obstructions between the mouth and Baxter, Ark., 182 miles.

The amount expended to June 30, 1907, was \$61,587.44. The project practically was completed in 1897 to McComb Landing, Ark., the present head of navigation, 141 miles, at a cost of \$45,873.53. This work resulted in safer navigation, increased the period to about six months of the year, enabled boats to make trips in half the time formerly required, and reduced freight rates about 50 per cent. There being no demand for navigation above McComb Landing, subsequent expenditures were for maintenance, and \$15,713.91 has been applied to that purpose.

Operations for maintenance during the fiscal year ending June 30, 1907, extended from the mouth to McComb Landing and put the stream in fair navigable condition.

<sup>a</sup> The estimate for completion refers only to that part of the project authorized by Congress for construction of Locks and Dams Nos. 2, 4, 6, and 8, at a cost of \$995,869.

<sup>b</sup> Of this amount, \$40,312 is under contract authorization of 1905 and \$360,823 under that of 1907.

The commerce consists of shipments of cotton, cotton seed, staves, saw logs, etc., with return freights of general merchandise and plantation supplies. Much of the trade has been diverted to railroads, as the stages of the bayou frequently are not coincident with the needs of transportation. The commerce for seventeen years ranges between a maximum of 49,299 tons in 1891 and a minimum of 2,007 tons in 1905, the average being 13,147 tons, valued at \$324,850.

The available funds will be applied to maintenance, and probably will be sufficient for two years' work.

July 1, 1906, balance unexpended.....	\$4, 681. 70
Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	5, 000. 00
	<hr/> 9, 681. 70
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	4, 269. 14
July 1, 1907, balance unexpended.....	<hr/> 5, 412. 56

(b) *Boeuf River, Louisiana.*—Before improvement this river was navigable to Point Jefferson, 151 miles, but passage was difficult and dangerous on account of overhanging timber and snags and logs in the channel.

The project adopted March 3, 1881, contemplated removing these obstructions to afford safe navigation at high stages to Wallace Landing, La., about 170 miles above the mouth. Under the river and harbor act of 1886 a supplemental project was entered upon for the closure of three outlets near Point Jefferson to confine the flow to the main channel.

The total expenditure to June 30, 1907, was \$64,789.68. The original project was completed in 1896 at a cost of \$40,994.29 (including \$1.45 from a refundment of overpayment). Since then \$18,353.61 (including \$31 from a refundment of overpayment) has been expended for maintenance. In 1887–88, by uniting with planters whose lands would be protected from overflow, the outlets near Point Jefferson were closed by earthen dams, the proportion of the cost borne by the United States having been \$5,441.78.

The work put the stream in safe navigable condition at stages high enough to permit steamboats to cross the bars and, when completed, enabled them to save thirty-six hours' time on a trip.

The closure of the outlets gave immediate benefit to navigation by concentrating the flow to the main stream, lengthening the period of navigation, and causing the bars to scour. The dams, however, were destroyed in 1890, during an overflow from Mississippi River, caused by crevasses in the levees near the headwaters of Boeuf River, and funds for their restoration have not been provided.

No work was done during the fiscal year ending June 30, 1907, as the amount available was not sufficient until after the act of March 2, 1907, and since then the stages were too high for effective operations.

The commerce consists of shipments of cotton, cotton seed, staves, etc., and return freights of general merchandise and plantation supplies, and for seventeen years ranges between a maximum of 11,261 tons in 1897 and a minimum of 545 tons in 1903; the average being 5,839 tons, valued at \$251,435.

The available funds probably will be sufficient for two years' work for maintenance by continuing the removal of obstructions. Steamboat men report that navigation is becoming more difficult each year, and additional interest in the project has revived through the necessity of draining Bayou Lafourche basin, into which the outlets flow, to permit development of a rich tract of land containing 220,800 acres, much of which has been converted into a swamp, and all of which is seriously affected by flood water from Boeuf River.

July 1, 1906, balance unexpended .....	\$1,042. 77
Amount allotted from appropriation by river and harbor act approved	
March 2, 1907 .....	5,000. 00
	<hr/>
	6,042. 77
December 8, 1906, amount transferred to Bayou Maçon .....	400. 00
	<hr/>
July 1, 1907, balance unexpended .....	5,642. 77

(c) *Tensas River and Bayou Maçon*.—Before improvement these streams were navigable at high stages, but the passage of steamboats was difficult and dangerous on account of leaning timber and numerous snags, logs, stumps, etc., in the channel.

The project adopted March 3, 1881, contemplated removing obstructions in Tensas River from its mouth to Dallas, La., 138 miles. Bayou Maçon, the chief commercial branch of Tensas River, was added under the same head of appropriation by river and harbor act of 1884, and the project contemplated the same kind of work from its mouth to Floyd, La., 112 miles.

The total expenditures to June 30, 1907, were \$53,397.86. The project for Tensas River was completed in 1898 to Westwood Place, 81 miles above the mouth, the head of navigation, at a cost of \$11,947.02, and the project for Bayou Maçon to Floyd was completed in 1899 at a cost of \$23,915.42. Lane Ferry, about 20 miles above Floyd, is the head of navigation in Bayou Maçon. The sum of \$17,535.42 has been expended for maintenance. The work put the two streams in fairly good navigable condition at medium and high stages. Upper Tensas River above Westwood Place practically is unnavigable by reason of leaning timber and obstructions in the channel, and there has been no recent effort to induce a resettlement of the abandoned plantations along its banks or to secure a continuance of the improvement to Dallas.

During the fiscal year ending June 30, 1907, work for maintenance was continued down Bayou Maçon 107 miles to its mouth and thence down Tensas River 69 miles to its mouth, removing the obstructions as thoroughly as possible.

The commerce consists chiefly of shipments of cotton, cotton seed, staves, etc., and return freights of plantation supplies. In seventeen years it has ranged between a maximum of 29,957 tons in 1905 and a minimum of 2,649 tons in 1893, the average being 14,251 tons, valued at \$530,580.

It is proposed to apply the available funds to maintenance, and the amount probably will be sufficient for two years' work.



July 1, 1906, balance unexpended-----	\$3,801.78
December 8, 1906, transferred from Boeuf River and Bayous D'Arbonne and Corney-----	800.00
Amount allotted from appropriation by river and harbor act approved March 2, 1907-----	5,000.00
	<hr/> 9,601.78
June 30, 1907, amount expended during fiscal year, for maintenance of improvement-----	4,490.64
	<hr/> 5,102.14
July 1, 1907, balance unexpended-----	28.56
July 1, 1907, outstanding liabilities-----	
	<hr/> 5,073.58

(d) *Bayous D'Arbonne and Corney, Louisiana.*—Before improvement navigation of these streams was difficult and dangerous on account of the leaning trees and the number of snags, stumps, etc., in the channel.

The project adopted July 5, 1884, contemplated removing the obstructions between the mouth of Bayou D'Arbonne and Stein Bluff on Bayou Corney, 40½ miles upstream. The river and harbor act of 1892 authorized an extension of work up Bayou Corney 16½ miles to Cobb Landing, and the act of 1894 provided \$1,000 for removing obstructions in the Little D'Arbonne Branch.

The amount expended to June 30, 1907, was \$22,032.61, and resulted in greater safety to navigation. The work practically was completed in 1896 at a cost of \$18,000. Subsequent expenditures for maintenance have amounted to \$3,032.61 and \$1,000 was expended for improving Little D'Arbonne Branch.

During the fiscal year ending June 30, 1907, 13 miles of lower Bayou D'Arbonne had been worked over when operations were suspended November 16, it being impracticable to proceed farther upstream at the low stage obtaining. In May a quarter boat was towed to Farmerville, near the mouth of Bayou Corney, at a moderately high stage, preparatory to resuming work as soon as the streams should recede to low water.

The commerce consists of shipments of cotton, cotton seed, etc., and return freights of plantation supplies. It varies considerably, and during eleven years ranged between a maximum of 29,137 tons in 1906 and a minimum of 682 tons in 1903, the average being 9,072 tons, valued at \$361,340.

It is proposed to apply the available funds to maintenance of the work.

July 1, 1906, balance unexpended-----	\$2,436.42
Amount allotted from appropriation by river and harbor act approved March 2, 1907-----	2,000.00
	<hr/> 4,436.42
June 30, 1907, amount expended during fiscal year, for maintenance of improvement-----	\$1,969.03
December 8, 1906, transferred to Bayou Maçon-----	400.00
	<hr/> 2,369.03
July 1, 1907, balance unexpended-----	2,067.39
July 1, 1907, outstanding liabilities-----	238.72
	<hr/> 1,828.67
July 1, 1907, balance available-----	

A condensed history of the work performed in Bayou Bartholomew, Boeuf River, and Tensas River and Bayou Maçon will be found in the Report of the Chief of Engineers for 1896, pages 1601-1613, and of that performed in Bayous D'Arbonne and Corney in the report of 1895, page 1914. Subsequent reports of the district officers refer only to the yearly operations.

An index to reports of examinations and surveys was published in the Report of the Chief of Engineers for 1904, page 391.

## CONSOLIDATED.

July 1, 1906, balance unexpended.....	\$11, 962. 67
Amount appropriated by river and harbor act approved March 2, 1907.....	17, 000. 00
	<hr/> 28, 962. 67
June 30, 1907, amount expended during fiscal year, for maintenance of improvement .....	10, 737. 81
July 1, 1907, balance unexpended.....	18, 224. 86
July 1, 1907, outstanding liabilities.....	267. 28
	<hr/> 17, 957. 58
(See Appendix W 3.)	

4. *Mouth of Yazoo River and harbor at Vicksburg, Miss.*—The shifting bar at the former mouth of the Yazoo was the most serious obstruction to navigation of that river and its tributaries, a system comprising about 800 miles of navigable waterways. At low stages steamboats were prevented from entering or leaving the river without lightering their cargoes across the bar, and it frequently happened that the outlet was entirely closed to navigation throughout the busiest season of the year.

Prior to 1876 the city of Vicksburg possessed the most commanding site and the finest harbor on the Mississippi River. There was deep water along the city front, and the entire width of the river was available for steamboats at all stages, with not less than 25 feet depth in any part of the harbor. The cut-off of April 27, 1876, and subsequent shoaling of the old channel from the river to the front of the city, practically destroyed the harbor, which became unnavigable except at high stages.

The original project for improving Vicksburg Harbor was entered upon under the river and harbor act of June 18, 1878. The first work consisted of revetting the rapidly caving bank at Delta Point, La., opposite Vicksburg, the continued recession of which was increasing the distance from the harbor to the river channel. The river and harbor act of August 2, 1882, placed the work under the Mississippi River Commission, and the revetment at Delta Point was continued until 1900. No work has been done since. Some caving has occurred above the upper end of the revetment, which is protected by a hard point, but there appears to be no immediate danger of flanking. The amount expended at Delta Point was \$389,486.08.

When Vicksburg Harbor was placed under the Mississippi River Commission in 1882 a project was adopted for dredging a basin, 1,700 feet long by 300 feet wide in front of the city, with a canal 150 feet

wide to connect it with the river. Dredging under this project amounted to 250,035 cubic yards in 1883, when discontinued. It was resumed in 1888, under a slightly modified project, and continued until 1893. During the latter period the dredging amounted to 1,729,994 cubic yards, making a total of 2,080,029 cubic yards of excavation. In 1888 pile dikes were built at the north end of the basin and along the west side of the canal, aggregating 6,800 feet in length. The expenditures for Vicksburg Harbor were \$442,724.77, which, added to the amount expended at Delta Point, makes a total of \$832,210.85. The improvement of Vicksburg Harbor was transferred to the Engineer Department under a provision of the river and harbor act of August 18, 1894.

The existing project, adopted by Congress in the river and harbor act of July 13, 1892, contemplated opening a new mouth or outlet for Yazoo River from its original mouth on Old River (9.8 miles above the former outlet to the Mississippi) through deep water down the wrong end of Old River, thence across a neck of lowland between Old River and Lake Centennial and around the head of De Soto Island and down the east arm of Lake Centennial to the Mississippi River, entering it upon the channel side at Kleinston Landing.

Lake Centennial is the old bend of the Mississippi River cut-off in 1876, and De Soto Island, prior to the cut-off, was the Louisiana peninsula, around which the river flowed. The estimate of cost—\$1,500,000—was revised in 1893 and reduced to \$1,200,000.

The work was completed in 1905 at a cost of \$1,179,210.87. Subsequent expenditures for maintenance amount to \$8,950.07. The new outlet was opened in the spring of 1903; uninterrupted navigation of Vicksburg Harbor has been maintained for four years, and the new mouth of Yazoo River has been open to boats of 6 feet draft at mean low water. The extreme range between high and low water at Vicksburg is 59 feet, but the usual variation is about 45.3 feet.

The chief features of this work were the purchase of 1,155.54 acres of land for right of way of the main cut from Old River to Lake Centennial; the clearing and grubbing of the entire route; the excavation by dredging of 6,229,281 cubic yards of earth in opening the new outlet, of which about 934,000 cubic yards was used for building a dam, above ordinary low water, across the west arm of Lake Centennial from mouth of the main cut to head of De Soto Island, and constructing a levee containing 429,677 cubic yards from mouth of the canal at Kleinston westward along West Pass bar (which separates the west arm of Lake Centennial from Mississippi River) to within about 4,500 feet of King Point.

The work performed during the fiscal year ending June 30, 1907, was for maintenance, principally for repairs and protection of the West Pass levee.

The annual commerce of Yazoo River, its tributaries, and Vicksburg Harbor, as reported for seven years, varied between 222,792 and 441,765 tons, the estimated values of which ranged from \$6,801,000 to \$13,272,000 per annum. The average of the commerce was 321,594 tons per annum, and the average value, \$8,753,650.

Maps of the work at Delta Point have been published in Annual Reports of the Chief of Engineers for 1883, 1884, 1888, 1889, 1893,

and 1900. Maps of Vicksburg Harbor accompany the reports of 1878 (p. 644), 1883, 1884, 1888, 1890, and 1893. Maps showing work under the existing project for diverting the mouth of Yazoo River, etc., accompany the reports of 1893, 1894, 1901, and 1902. Fifteen photographs were printed in the report for 1900.

July 1, 1906, balance unexpended.....	\$15, 294. 94
June 30, 1907, amount expended during fiscal year, for maintenance of improvement .....	3, 455. 88
July 1, 1907, balance unexpended .....	11, 839. 06
July 1, 1907, outstanding liabilities.....	560. 16
July 1, 1907, balance available.....	11, 278. 90

(See Appendix W 4.)

5. *Yazoo, Tallahatchie, Coldwater, and Big Sunflower rivers, and Tchula Lake, Mississippi.*—These improvements were consolidated by river and harbor act of June 13, 1902. The same kind of work is required in all, i. e., the removal of wrecks, snags, stumps, tree slides, sunken logs, leaning timber, etc., for maintenance of navigation.

(a) *Yazoo River.*—Before improvement the period of navigation was limited to high stages on which steamboats could pass the wrecks of gunboats, steamers, and raft sunk during the civil war. The channel was much obstructed also by snags, stumps, tree slides, leaning timber, etc.

The project entered upon March 3, 1873, provided \$40,000 for the removal of nine wrecks. Subsequent acts of Congress provided for continuing the improvement and for maintenance. There is no practical distinction between improvement and maintenance, as floods, sliding and caving banks, and the rapid growth of vegetation along alluvial streams of this kind constantly add obstructions and render a continuance of snagging operations necessary in the interest of safe and uninterrupted navigation.

The total expenditure to June 30, 1907 (including \$110.46 derived from sales), was \$349,100.51, which has resulted in safe and uninterrupted navigation from mouth to head of the river the year round for more than twenty years. Steamboats of 3½ feet draft navigate the river at mean low water without serious difficulty.

During the fiscal year ending June 30, 1907, snagging operations, etc., for maintenance extended over the entire river. Work at Jeffersonville, Ind., under contract, for the construction of a new steel snag boat, to replace the *John R. Meigs* (destroyed in 1898), was continued during the year, and the boat is about 50 per cent finished.

The range between high and low water at Yazoo City is 40.8 feet.

It is proposed to apply the available funds to continuing work for maintenance of the improvement and completing the new snag boat. The amount will be sufficient for two years' operations.

July 1, 1906, balance unexpended.....	\$82, 904. 79
Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	36, 000. 00
Amount received from sales of property.....	84. 50

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118, 989. 29

June 30, 1907, amount expended during fiscal year:	
For constructing snag boat.....	\$17, 297. 73
For maintenance of improvement.....	8, 681. 61
July 12, 1906, transferred to Tallahatchie River.....	5, 000. 00
	<hr/> 30, 979. 34

July 1, 1907, balance unexpended.....	88, 009. 95
July 1, 1907, outstanding liabilities.....	735. 40

July 1, 1907, balance available.....	<hr/> 87, 274. 55
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July 1, 1907, amount covered by uncompleted contracts.....	<hr/> 27, 189. 12
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(b) *Tallahatchie and Coldwater rivers.*—Before improvement Tallahatchie River was navigable to Sharkey, about 65 miles above its mouth, for six months of the year, but passage was difficult and dangerous on account of the number of obstructions in the channel and along the banks, and the wreck of the ocean steamship *Star of the West*, sunk February, 1863, 8 miles above the mouth. Above Sharkey the growth of leaning timber was so dense and the channel so obstructed by snags, etc., that that part of the stream practically was unnavigable. The same conditions continued up the Coldwater River.

The project entered upon March 3, 1879, contemplated removing obstructions in Tallahatchie River from the head of Yazoo River to the mouth of Coldwater River and up the Coldwater about 80 miles to Yazoo Pass. Work in the Coldwater River was abandoned in 1881, but was resumed under a provision of the river and harbor act of 1905.

The amount expended to June 30, 1907 (including 4 cents, refundment of overpayment), was \$75,976.80, and the work performed permits steamboats of 3 feet draft to run to Sharkey the year round and into Coldwater River at moderately high stages.

Marks, on Coldwater River, is considered the present head of navigation, and boats rarely run above that place.

During the fiscal year ending June 30, 1907, work for the removal of obstructions was continued down Coldwater River from Jamison Place to its mouth, and thence down Tallahatchie River to Locopolis.

Operations for maintenance will be continued with the available funds.

July 1, 1906, balance unexpended.....	\$1, 105. 19
July 12, 1906, transferred from Yazoo River.....	5, 000. 00
Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	5, 000. 00

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11, 105. 19

June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	5, 581. 95
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July 1, 1907, balance unexpended.....	<hr/> 5, 523. 24
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(c) *Tallahatchie River above mouth of Coldwater River to Batesville.*—To comply with requirements of river and harbor acts of 1880, 1881, and 1882, a total expenditure of \$10,000 was made to clear this

stretch of obstructing trees, stumps, and snags, after which work was discontinued by the United States. Commerce was revived in 1904, and, after the worst obstructions had been removed by popular subscription, about 2,100 tons of stave and spoke billets and other freight, valued at \$100,000, was transported by steamboat.

The project entered upon March 2, 1907, contemplates an expenditure of \$2,000 a year for a series of years to put the river in such condition that boats plying the lower Tallahatchie can safely run to Batesville for five to seven months of the year. Eventually the cost of maintenance will be reduced to \$1,000 per year.

At a moderately high stage in May, 1907, a quarter boat was moved to Batesville, where active operations commenced, and at the close of the fiscal year had been carried downstream 7 miles.

Reports on examination and survey are printed in House Document No. 147, Fifty-ninth Congress, first session.

Amount appropriated by river and harbor act approved March 2, 1907.	\$4,000.00
June 30, 1907, amount expended during fiscal year, for maintenance of improvement	855.37

July 1, 1907, balance unexpended	3,144.63
July 1, 1907, outstanding liabilities	1,103.06

July 1, 1907, balance available	2,041.57
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(d) *Big Sunflower River*.—Before improvement this stream was navigable about six months of the year, but was obstructed by snags, sunken logs, sand bars, and shoals; navigation was impeded by leaning timber, and at many places the channel was so choked with obstructions and so narrow that it afforded passage for the smallest craft only.

The project entered upon March 3, 1879, contemplated the removal of obstructions between the mouth and Clarksdale, about 180 miles, and the building of inexpensive pile and brush wing dams to scour depths of about 40 inches at the bars. Prior to the building of the Mississippi River levees, and since, when crevasses in the levees occurred, this stream carried large quantities of overflow water and its section was increased thereby. In this enlarged bed the normal river at low stages now flows between secondary banks and, as a rule, the main banks are not overtopped by floods, except near the mouth, where the flood height is affected by backwater from the Mississippi.

On account of the changed conditions, the river and harbor act of March 2, 1907, placed the upper limit of improvement at the mouth of Hushpuckena River, about 30 miles below Clarksdale; authorized a continuation of the work of removing obstructions below that point, and an improvement of the lower section, below Baird, about 87 miles, with a view to obtaining a navigable depth of 3 feet by means of the closure of outlets and more extensive contraction works. The estimates of cost for work below Baird were \$75,000 for the necessary closing dams, about \$10,000 per year for five years for continuation of the open-river work, and \$5,000 per year thereafter.

The amount expended to June 30, 1907, was \$101,637.44. The cutting of leaning timber, removal of channel obstructions, and the building and renewal of wing dams at the bars maintained navigation in the lower 100 miles of river, and enabled boats of 30 inches

draft to run to Woodburn, about 77 miles above the mouth, at mean low water. Faison, about 100 miles above the mouth, is considered the head of navigation.

During the fiscal year ending June 30, 1907, operations for maintenance continued for three months during the period of low water, extended over various stretches between the mouth and a point about 6 miles above Doddsville, in Sunflower County, but were not thorough on account of the short season and limited plant available for work.

It is proposed to apply \$75,000 of the available funds to the purpose of closing outlets in the lower 30 miles and the remainder to a continuance of snagging operations and the building and repair of wing dams where required.

Examination and survey reports are printed in House Document No. 667, Fifty-ninth Congress, first session.

July 1, 1906, balance unexpended.....	\$4, 913. 16
Amount appropriated by river and harbor act approved March 2, 1907.....	100. 000. 00
	<hr/>
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	104, 913. 16
	<hr/>
July 1, 1907, balance unexpended.....	3, 550. 60
July 1, 1907, outstanding liabilities.....	<hr/>
	101, 362. 56
	<hr/>
July 1, 1907, balance available.....	1, 578. 49
	<hr/>
	99, 784. 07

(e) *Tchula Lake*.—This is an arm of Yazoo River, about 60 miles long, and east of Honey Island, in Holmes County. Before improvement it was obstructed its entire length by a network of snags, heavy leaning timber, and a thick growth of brush along both banks.

The project adopted March 3, 1881, contemplated removal of the obstructions to prolong the navigable period and to permit light-draft steamboats to pass through the lake earlier in the cotton season.

The amount expended to June 30, 1907, was \$28,709.35. The work was practically completed and the stream put in safe navigable condition in 1895 at an expenditure of \$21,000. Since 1902 \$7,709.35 has been expended for maintenance.

The available funds will be applied to continuing work for maintenance.

July 1, 1906, balance unexpended.....	\$3, 951. 92
Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	4, 000. 00
	<hr/>
	7, 951. 92
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	<hr/>
	3, 661. 27
	<hr/>
July 1, 1907, balance unexpended.....	4, 290. 65

The chief shipments out of Yazoo River and tributaries are cotton, cotton seed, staves, timber, etc., with return freights of general merchandise and plantation supplies. The commerce of sixteen years ranges between 102,098 and 544,503 tons annually, with values estimated at \$2,840,000 to \$9,198,000, the average being 231,528 tons, valued at \$5,498,500.

Freight rates on cotton by boat are about 50 per cent less than by rail; on cotton seed about  $33\frac{1}{3}$  per cent less. Live-stock shipments by boat cost about one-third of the railroad rates, and grain, flour, meal, and provisions shipped by boat cost about 50 per cent less than by rail. To inland points the railroad rates are largely in excess of boat rates for the same distance. Large quantities of timber are rafted which could not be reached by rail.

A résumé of the work performed in Yazoo, Tallahatchie, and Big Sunflower rivers is given in the Report of the Chief of Engineers for 1896, pages 1613, 1626, and 1630. Subsequent annual reports of the district officers give each year's operations only. A résumé of work in Coldwater River is given in the Report of the Chief of Engineers for 1885, page 1518.

An index to reports of examinations and surveys was published in the Report of the Chief of Engineers for 1904, page 397. Reports of examinations of Tallahatchie River above mouth of Coldwater to Batesville, and of Big Sunflower River, made in 1905, were printed in House Documents Nos. 147 and 667, Fifty-ninth Congress, first session.

## CONSOLIDATED.

July 1, 1906, balance unexpended.....	\$92, 875. 06
Amount received from sales.....	84. 50
Amount appropriated by river and harbor act approved March 2, 1907.....	149, 000. 00
	<hr/>
	241, 959. 56
June 30, 1907, amount expended during fiscal year:	
For constructing snag boat.....	\$17, 297. 73
For maintenance of improvement.....	22, 330. 80
	<hr/>
	39, 628. 53
July 1, 1907, balance unexpended.....	202, 331. 03
July 1, 1907, outstanding liabilities.....	3, 416. 95
	<hr/>
July 1, 1907, balance available.....	198, 914. 08
	<hr/>
July 1, 1907, amount covered by uncompleted contracts.....	27, 189. 12
(See Appendix W 5.)	

## IMPROVEMENT OF ARKANSAS RIVER AND OF CERTAIN RIVERS IN ARKANSAS AND MISSOURI.

This district was in the charge of Maj. Graham D. Fitch, Corps of Engineers, to July 24, 1906, and in the temporary charge of Capt. W. D. Connor, Corps of Engineers, since that date. Division engineer, Lieut. Col. Clinton B. Sears, Corps of Engineers, to July 16, 1906, and Col. E. H. Ruffner, Corps of Engineers, since that date.

1. *Arkansas River, Arkansas.*—In its original condition the channel of the river was greatly obstructed by shifting sand bars and numerous snags in its lower reaches, and by gravel and rock shoals and some snags in its upper reaches. Navigation was difficult and uncertain at medium and low stages, and during periods of extreme low water was impossible.

Prior to act of Congress approved June 13, 1902, the work on this river was carried on under two general projects—one entitled "Removing obstructions in Arkansas River, Arkansas and Kansas," the other "Improving Arkansas River, Arkansas."



The original project for "Removing obstructions in Arkansas River, Arkansas and Kansas" (act July 3, 1832), was to remove snags and wrecks. Subsequently this project was enlarged to include removing bars by wing dams, and many of the appropriations were made for this work in combination with other rivers. By act of March 3, 1879, Congress adopted an additional project—that of improving the river between Fort Smith, Ark., and Wichita, Kans., by removing the snags and rocks and constructing dams at some of the worst shoals. Later these projects were merged into one, making the project extend from the mouth of the river to Wichita. Under these projects there was expended to June 30, 1902, \$968,256.81.

The original projects for "Improving Arkansas River, Arkansas," were local and had in view the permanent improvement of the river at Fort Smith, Van Buren, Dardanelle, and Pine Bluff. By act of August 11, 1888, Congress adopted a general project, namely, "That the Secretary of War shall expend the appropriation under this head with reference to the final improvement of this river as contemplated in the Report of the Chief of Engineers for the year ending July 1, 1885, and as authorized in the act for the improvement of rivers and harbors approved August 5, 1886, and in House Executive Document No. 90, Forty-ninth Congress, first session, said methods to be applied as the Secretary of War may direct at such points between Wichita, Kans., and the navigable mouth of the Arkansas River at its junction with the Mississippi River, as he may deem for the best interest of commerce." The "said methods" referred to in the act were "to remove rock and gravel reefs by blasting and dredging, to contract the channel by dikes and dams, permeable or solid, of such construction as the local conditions require, and to hold the channel so obtained by revetment where necessary." The improvement authorized by the act covers 771 miles, while estimates have been rendered for 708 miles, thus making the estimated cost of the improvement under this project indefinite. Act of August 18, 1894, authorized the operation of snag boats under this head in addition to similar operations under the project "Removing obstructions in Arkansas River, Arkansas and Kansas." To the close of the fiscal year ending June 30, 1902, there had been expended under the general project for improving Arkansas River, Arkansas, \$903,311.93 for original construction, \$314,119.14 for maintenance, and \$63,397.32 for operating snag boats, making the total amount \$1,280,828.39.

Act of Congress approved June 13, 1902, merged these two general projects into one, which makes the existing project in substance: "The improvement of the river from its mouth to the head of navigation by snagging operations, by dredging operations, and by contraction works, holding the improved channel by revetment where necessary." No definite estimate of cost can be given.

The river and harbor act of March 2, 1907, made available for maintenance of this improvement amounts previously appropriated for work in vicinity of Redfork levee or set apart for dredging. The act provided also for an examination of the river to Muskogee, Ind. T., by a Board of Engineers, with a view to devising a plan for further improvement, and made a conditional appropriation for work at Pine Bluff, if deemed by the Board to be necessary in the interest of navigation. Funds from this appropriation will be applied to work in pursuance of the Board's recommendation.

To June 30, 1907, there had been expended under the consolidated project \$135,472.12, of which \$106,378.07 was for operating snag boats, \$8,624.05 for operating a hydraulic dredge, and \$20,470 for maintaining works of permanent improvement. The total expenditure under all projects to June 30, 1907, is \$2,384,557.32, of which \$1,138,032.20 is for operating snag boats, \$8,624.05 for operating hydraulic dredge, \$903,311.93 for original construction of works of permanent improvement, and \$334,589.14 for maintenance of those works.

The works erected for the permanent improvement of the stream were of no material benefit to navigation, they having been built in disconnected reaches. The snagging operations, which must be repeated each year, give immediate relief, but the benefits derived from them are in a large measure lost during the high-water seasons following the periods when the work is done. This is due to the continual caving of the banks and the consequent shifting of the channels.

Fort Gibson, on Grand River, 2 miles above its mouth and 463 miles from the mouth of the Arkansas River, is the head of steamboat navigation. The duration of the navigable periods of the river varies greatly in different years. Occasionally there are periods of very low water, when navigation will be suspended throughout the length of river, and then there will be times when it is possible to maintain 3-foot navigation through to Fort Gibson all the year. The navigation periods are of about the following averages:

	Months a year for 4- foot draft.	Months a year for 2- foot draft.
Mouth to Swan Lake (80 miles) .....	5½	10
Mouth to Little Rock (174 miles) .....	5	9½
Mouth to Grand River (461 miles) .....	4	8

The range between extreme high water and extreme low water at Fort Smith, Ark., is 35.5 feet; at Little Rock, Ark., 28.5 feet, and at the mouth of the river where the stages are controlled by those of the Mississippi the extreme range is 53.7 feet.

The operations of this fiscal year consisted of operating the snag boats *Quapaw*, *Arkansas*, and *C. B. Reese* and the hydraulic dredge *Gamma*. By the operations of the snag boats 904 snags were removed from the channel, 7,895 trees cut on caving banks, and 5 drifts broken up between Poverty Point (8 miles above the mouth of the river) and Little Rock (174 miles above the mouth of the river). By the operations of the dredge *Gamma* shoal crossings at Bickers bend (56 miles above the mouth), Hannaberry (68 miles above the mouth), Pleasants (73 miles above the mouth), and Robroy (99 miles above the mouth) were deepened. The dredge is working at Swan Lake (80 miles above the mouth) at the close of the year. Hydraulic dredging is new work for this river, and the work done this year was experimental. It has not yet been carried on long enough to warrant one to make any definite statements as to its worth to navigation interests.

The river was at comparatively good boating stage all the year.

Of the balance available July 1, 1907, it is proposed to expend \$58,048.83 in operating snag boats and \$29,173.40 in continuing

hydraulic dredging at such times as the Mississippi River Commission can spare a dredge for use in this river.

Information as to the effect of the improvement on freight rates is meager, but indicates that a material reduction has resulted.

*Commercial statistics, year ending May 31.*

Year.	Tons.	Value.	Year.	Tons.	Value.
1894.....	63,563	\$2,846,895	1901.....	71,998	\$2,623,797
1895.....	50,493	2,380,420	1902.....	40,557	1,630,297
1896.....	54,261	2,408,720	1903.....	86,068	2,389,020
1897.....	66,077	1,657,218	1904.....	92,041	2,078,893
1898.....	58,578	1,626,756	1905.....	86,458	1,636,930
1899.....	68,057	2,470,181	1906.....	103,214	1,512,719
1900.....	75,654	2,078,940	1907.....	104,593	2,192,531

The commerce was made up of plantation products and supplies, cooperage stuffs, and saw logs, the latter making 54 per cent of it.

Reference to the principal examinations and surveys is given on page 401 of the Annual Report for 1904.

July 1, 1906, balance unexpended..... \$88,024.23

Amount appropriated by river and harbor act approved March 2, 1907..... 35,000.00

Receipts from sales..... 23.70

123,047.93

June 30, 1907, amount expended during fiscal year, for maintenance of improvement..... 26,296.68

July 1, 1907, balance unexpended..... 96,751.25

July 1, 1907, outstanding liabilities..... 9,529.02

July 1, 1907, balance available..... 87,222.23

(See Appendix X 1.)

2. *White River, Arkansas.*—In its original condition this river was much choked by logs, snags, and drift in its lower reaches, and in its upper reaches—i. e., above Jacksonport—by gravel shoals, bowlders, and some snags.

The original project (act of March 3, 1871) was to remove snags and similar obstructions, the work being combined with similar work on Black and Little Red rivers. Act of June 23, 1874, extended the improvement to Forsyth, Mo., the project being to remove snags and bowlders and to contract the water width at shoals. During the period 1873–1884 the snagging operations on the lower river were in connection with similar work on St. Francis River, while the improvement above Jacksonport was under appropriations confined to that portion of the stream. The act of July 5, 1884, was the first independent appropriation for the river as a whole. It readopted and consolidated into one the separate projects and provided for a survey with a view to the permanent improvement of the river from Forsyth, Mo., to the mouth. The project of 1888 (Annual Report of the Chief of Engineers for 1888, p. 1406) was to deepen the water on shoals by contracting the channel, and to remove rock, bowlders, and snags from the channel, the object being to obtain a channel 5 feet deep at low water from the mouth to Newport and 2 feet deep thence to Buffalo shoals, at an estimated cost of \$105,815, with an additional amount of \$8,000 a year for two or three years for snagging. For reasons given in the Annual Report of the Chief of Engineers for

1891, page 2049, the estimates were inadequate to accomplish the object. The act of July 13, 1892, appropriated \$53,815 to complete the project, and an additional sum of \$21,185 to be expended "in the discretion of the Secretary of War." These funds and those appropriated since have been expended on the lines of the project of 1888, with the addition of dredging on the shoals. The act of March 3, 1899, adopted a lock-and-dam project for the improvement of this river above Batesville, thus reducing the scope of the former project to improving the river from the mouth to Batesville by contracting the channel, by removing rocks, bowlders, and snags, and by dredging, the expenditures to be made in the discretion of the Secretary of War.

The river and harbor act of March 2, 1907, directed an examination of the river at Augusta Narrows to be made by a Board of Engineers, and provided funds conditionally for work at said locality, if deemed by the Board to be in the interest of navigation. Funds from this appropriation will be applied to work in pursuance of the Board's recommendation.

It is not practicable to state the expenditures on this river when the work was carried on in connection with other rivers. From the separate appropriations for the whole river, or for reaches of it, to the close of the fiscal year ending June 30, 1907, there had been expended \$429,986.35. Of this amount \$4,000 was allotted to Cache River, \$11,061.46 was spent on special works at Batesville, \$166,000 was on projects prior to that of 1888, \$108,815 was for original construction under the project of 1888, and \$139,795.05 on maintenance of works and on snagging and dredging, and \$314.84 on prevention of cut-off near Augusta, Ark.

In a few instances the contraction works above Jacksonport gave a slight increase in channel depth, but, on the whole, there was not enough improvement in the channel to be of any material benefit to navigation; the dredging between Jacksonport and Batesville in fiscal year 1898 made a channel 3 feet deep during one low-water season, but the dredging has not been continued, no plant being available; the snagging operations make the natural depths of the stream available during the low-water season in which the snagging is done. The winter and the spring floods following bring other obstructions into the stream; hence snagging operations are needed every year.

Forsyth, Mo. (505 miles above the mouth), is the head of steam-boat navigation. From its mouth to Jacksonport, 264 miles, the river is generally spoken of as being navigable at any time for boats of not over 3-foot draft. Between Jacksonport and Batesville, where Lock No. 1 of the upper White River improvement is located, the low-water channel depths are approximately 16 inches.

The range between extreme high water and extreme low water below Dam No. 1 at Batesville is 35.5 feet; at Jacksonport, 34.4 feet; at Clarendon, 32.5 feet, and at the mouth of the river 53.7 feet.

On page 1668 of the Annual Report of the Chief of Engineers for 1896 there is given the location of all the principal works built for the improvement of this river. Report of survey from Forsyth, Mo., to the mouth, with plans for improvement, is given in the Annual Report of the Chief of Engineers for 1888, page 1406.

The operations this fiscal year were confined to operating the snag boat *Quapaw* between Poverty Point (8 miles above the mouth of the river) and Batesville (301 miles above the mouth of the river). By

these operations 207 snags were removed from the channel, 5,352 trees cut on caving banks, and 2 drifts broken up.

The river was at fine boating stage all the year.

*Commercial statistics, year ending May 31.*

Year.	Tons.	Value.	Year.	Tons.	Value.
1895.....	73,759	\$2,494,877	1902.....	184,066	\$1,242,438
1896.....	74,882	2,056,991	1903.....	140,013	882,225
1897.....	73,962	2,435,814	1904.....	193,498	1,021,778
1898.....	102,337	1,415,013	1905.....	134,588	770,689
1899.....	117,891	1,619,351	1906.....	100,083	766,138
1900.....	134,696	2,244,222	1907.....	127,812	830,659
1901.....	148,574	1,700,355			

Thirty-three per cent of the tonnage reported this fiscal year was rafted saw logs and railway ties floated with the current. Lumbering and kindred industries also make up the bulk of the steamboat commerce, full report of which was not received.

Information as to the effect of the improvement on freight rates is meager, but indicates that a material reduction has resulted.

July 1, 1906, balance unexpended.....	\$2, 882. 42
Amount appropriated by river and harbor act approved March 2, 1907.....	30, 000. 00
Receipts from sales.....	12. 10

	32, 894. 52
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	3, 953. 77

July 1, 1907, balance unexpended.....	28, 940. 75
July 1, 1907, outstanding liabilities.....	910. 91

July 1, 1907, balance available.....	28, 029. 84
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(See Appendix X 2.)

3. *Upper White River, Arkansas.*—Earlier works on this portion of White River were made under appropriations for improving White River, Arkansas, and have been fully reported upon under that head.

The original condition of the river and previous projects for its improvement are also reported there.

The existing project, adopted March 3, 1899, is based on a report printed in the Annual Report of the Chief of Engineers for 1897, page 1992, and is to provide slack-water navigation from Batesville, Ark., to Buffalo shoals, 89 miles, by 10 fixed dams with concrete locks. The locks are to be 175 feet between hollow quoins and 36 feet wide, with a depth of about 4 feet on the lower miter sills. The estimated cost is there given as \$1,600,000 for the 10 locks and dams.

A Board of Engineers appointed pursuant to requirement of the river and harbor act of March 3, 1905, to consider this project, has submitted its report, and reference thereto will be found on page 460 of the report for 1906. The district officer is of the opinion that the total cost of Lock and Dam No. 3 will be \$233,500, and states that \$73,500 will be required to complete it.

To the close of the fiscal year ending June 30, 1907, there had been expended on this work \$732,612.86. Two locks and dams, Nos. 1 and 2, have been completed and placed under the indefinite appropriation "Operating and care of canals and other works of navigation."

The walls and upper guide cribs of Lock No. 3 and the abutment for Dam No. 3 have been built. About 85 per cent of the timber needed for the construction of Dam No. 3 is on the ground, and excavation for the dam has been commenced.

Forsyth, Mo., 204 miles above Batesville, is the head of steamboat navigation. The channel depths over the shoals in the unimproved part of the river are small, being only 8 to 10 inches during lowest waters. The range between high and low water at Buffalo City, the head of this project, is about 45 feet. Below Dam No. 1, at Batesville, this range is 35.5 feet.

*Commercial statistics, year ending May 31.*

Year.	Tons.	Value.	Year.	Tons.	Value.
1899.....	9,059	\$548,335	1904.....	15,655	\$53,942
1900.....	39,253	1,260,716	1905.....	12,496	42,736
1901.....	23,522	639,855	1906.....	11,188	61,819
1902.....	27,472	758,040	1907.....	14,285	89,156
1903.....	16,315	737,080			

The only boats reported as having navigated this river this fiscal year were the steamboat *Liberty* and the gasoline boat *Angeline*. The former boat made one trip with a cargo of shoes from St. Louis, Mo., for White River points, delivering a part of the cargo at Batesville; the latter boat was engaged in barging wheel stock and cooperage stuffs to Batesville. Eighty-five per cent of the commerce reported was rafted railway ties, logs, and cedar. Batesville parties have purchased a steamboat and intend operating a barge line between Batesville and points above.

July 1, 1906, balance unexpended.....	\$55,890.22
Amount appropriated by river and harbor act approved March 2, 1907.....	73,500.00
Receipts from sales.....	1.84

	129,392.06
June 30, 1907, amount expended during fiscal year, for works of improvement.....	48,503.08

July 1, 1907, balance unexpended.....	80,888.98
July 1, 1907, outstanding liabilities.....	16,599.65

July 1, 1907, balance available.....	64,289.33
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July 1, 1907, amount covered by uncompleted contracts.....	12,366.65
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(See Appendix X 3.)

4. *Operating and care of Locks and Dams Nos. 1 and 2, upper White River, Arkansas.*—These locks and dams were built from funds derived from appropriations for improving upper White River, Arkansas. The available length of the locks is 147 feet, available width is 35 feet, and depth over the miter sills at normal pool levels is 5 feet. Lock and Dam No. 1 was placed under this appropriation on January 16, 1904; Lock and Dam No. 2, on February 16, 1905.

The high-water mark of May, 1898 (before the dams were built), is 22 feet above the crest of Dam No. 1 and 18.4 feet above the crest of Dam No. 2. The highest stages reached by the river since the dams have been completed were 20 feet above the crest of Dam No. 1 and

18.2 feet above the crest of Dam No. 2, on May 8, 1907. The lowest stages this fiscal year were 0.8 foot above the crest of Dam No. 1, August 8, 1906, and 0.9 foot above the crest of Dam No. 2, November 16, 1906.

The expenditures this fiscal year were for ordinary operating expenses of the locks, for repairs of high-water damages done by the high water in March of last fiscal year and in May of this fiscal year, for the construction of four barges, and the partial construction of quarter boat. The damage done by the high water in May of this fiscal year has been only partially repaired, and the quarter boat is not yet completed, because of delay in receiving lumber.

The total amount expended under this head to June 30, 1907, is \$71,601.89, of which \$26,842.23 was expended this fiscal year.

*Commercial statistics, year ending May 31.*

	Lock No. 1.				Lock No. 2.				Open river.
	Lock-ages.	Powered boats.	House boats and other craft.	Freights.	Lock-ages.	Powered boats.	House boats and other craft.	Freights.	Freights that did not pass through a lock.
	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>	<i>Tons.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>	<i>Tons.</i>	<i>Tons.</i>
1904.....	<sup>a</sup> 115	4	6	8,320	.....	.....	.....	.....	7,335
1905.....	244	1	53	8,771	<sup>b</sup> 60	1	2	4,163	5,000
1906.....	246	9	136	7,306	183	10	43	8,692	2,496
1907.....	191	3	96	6,798	263	86	82	9,431	1,283

<sup>a</sup> Four months.

<sup>b</sup> Three and one-half months.

(See Appendix X 4.)

5. *Cache River, Arkansas.*—In its original condition this river was much obstructed by snags, drift, and overhanging timber. The low-water depth on the controlling shoals was 6 to 8 inches.

The original project, adopted by act of August 11, 1888, was to remove logs, snags, and overhanging timber from the mouth to River-side (102 miles). The amount expended on this project was \$9,000.

Acts of August 18, 1894, and June 3, 1896, each authorized the Secretary of War to expend \$2,000 of the White River appropriation on this stream. These funds were expended in snagging operations from the mouth of the river to James Ferry, 79 miles, in accordance with a project adopted in 1888. Acts of March 3, 1899, and June 13, 1902, made independent appropriations for this stream. These were expended in snagging operations between the mouth of the river and James Ferry along the lines of the 1888 project, under which there has been expended \$9,000 to June 30, 1907, the entire expenditure being for maintenance of channel. The operations prior to fiscal year 1904 were of material benefit to commerce, by lengthening the navigable period and rendering the natural depths of the stream available for navigation purposes. The small amount of work done in fiscal year 1906 was not sufficient to restore the river to the condition that existed when work ceased in the autumn of 1902. Nothing was done this fiscal year, and the river is again badly choked with drift and fallen timber.

Gray's bridge, 95 miles above the mouth of the river, is considered the head of steamboat navigation, but the river is not navigable to

that point all the year, the ruling depth in the channels over the shoals throughout the river being only 8 to 10 inches during lowest water. During high-water seasons rafts are run from 100 or more miles above Gray's bridge. In the vicinity of James Ferry (79 miles above the mouth of the river and the upper limit of snagging operations now) the range between high and low water is about 15 feet. Because of backwater from White River this range is increased to 24 feet at Rock Island Railway bridge and to 32 feet at the mouth of the river.

Reports of the more recent preliminary examinations of this river are given in the Annual Report of the Chief of Engineers for 1887, page 1547, and in the Annual Report of the Chief of Engineers for 1895, page 2037.

*Commercial statistics, year ending May 31.*

Year.	Tons.	Value.	Year.	Tons.	Value.
1895 .....	12, 603	\$25, 494	1902 .....	15, 676	\$40, 301
1896 .....	20, 748	62, 433	1903 .....	16, 843	109, 681
1897 .....	34, 990	108, 460	1904 .....	15, 865	49, 601
1898 .....	10, 193	36, 635	1905 .....	11, 660	29, 860
1899 .....	7, 667	52, 936	1906 .....	10, 942	31, 777
1900 .....	11, 215	29, 961	1907 .....	13, 050	39, 225
1901 .....	10, 374	30, 100			

The tonnage reported for this fiscal year was made up entirely of rafted saw logs and railway ties floated with the current.

The balance available July 1, 1907, will be expended in snagging operations below James Ferry.

Amount appropriated by river and harbor act approved March 2, 1907— \$2, 000. 00  
 July 1, 1907, balance unexpended..... 2, 000. 00

(See Appendix X 5.)

6. *Black and Current rivers, Arkansas and Missouri.*—Prior to fiscal year 1905 the work on these rivers was provided for under separate appropriation titles. The works were consolidated by river and harbor act of March 3, 1905.

(a) *Black River.*—In its original condition this river below the mouth of Current River had, at ordinary low water, a controlling depth of 2 to 2½ feet on the shoals, but this was not available on account of snags and similar obstructions. Above the mouth of Current River navigation was practically impossible at ordinary low stages, and no rafting was possible above the Arkansas and Missouri State line.

The original project, adopted by act of June 14, 1880, contemplated removing logs, etc., cutting down shoals by means of wing dams, and closing some of the most troublesome sloughs. The estimated cost was \$80,800. The only modification of the project has been that of changing the estimate to \$8,000 a year for maintenance. The district officer recommends that this be increased to \$15,000.

To June 30, 1907, there had been expended on this work \$154,-394.35.

Poplar Bluff, Mo., 239 miles above the mouth of the river, is the head of navigation. All-the-year navigation has been made possible to this



place for boats of not over 18 inches draft. Boats of not over 2½ feet draft can navigate this river below the mouth of Current River, 116 miles, during the lowest waters, and this portion of the river is generally spoken of as being navigable for 3-foot boats at any time.

The range between high and low water at Poplar Bluff is 19 feet. This difference decreases below Poplar Bluff, and in the flat lands to the southward it averages about half of this, being 8.5 feet at Corning bridge, 70 miles below Poplar Bluff. After passing to below head of Little River the difference between high and low waters increases, and at Pocahontas, 129 miles below Poplar Bluff, the difference is 26.5 feet, and at the mouth of the river it is 34.4 feet.

The operations this fiscal year have been confined to the usual snagging operations, the snag boat *Riverside* (hand propelled) being operated above the mouth of Current River, and the snag boat *Quapaw* being operated below that point. By the combined operations of these boats 1,070 snags were removed from the channel, 4,450 trees cut, and 9 drifts broken. The river was at good boating stage all the year.

The report of the examination upon which the present project for the improvement of Black River is based is given in the Annual Report of the Chief of Engineers for 1880, page 1326.

(b) *Current River*.—The original condition of this stream was such that no steamboat navigation above the mouth of Little Black River was attempted except when the river was at high stages. Below Little Black River navigation was suspended when the river was below medium stage. The natural depths were not available on account of snags and leaning trees.

Although the United States made some improvements to this stream in 1873, and again in 1882 and 1883, the regular improvement of it was not undertaken until act of Congress of August 18, 1894, adopted a project for its improvement from Van Buren, Mo., to the mouth, by snagging operations and by contracting the channel at the worst shoals by wing dams, at an estimated cost of \$10,000. The appropriation of June 3, 1896, completed the amount originally estimated for the completion of the project, and all operations since then have been under estimates for maintenance. No wing dams have been built, all operations having been confined to snagging.

To June 30, 1907, there has been expended on this river \$36,805.85, \$7,000 of which was in the early work mentioned above, leaving \$29,805.85 as the amount expended on the existing project. Of this latter amount, \$19,805.85 was for maintenance.

Reference to the preliminary examination of this stream and to a subsequent examination of it is given on page 408 of Annual Report for 1904.

Van Buren, Mo., 94.5 miles above the mouth of the river, was taken as the head of navigation when the earlier projects for this river were adopted. Small gasoline boats occasionally ply the river that far up, and rafts are run over the entire river, but Pitmans Landing, near the State line between Arkansas and Missouri and 41 miles above the mouth of the river, is generally spoken of as the head of steamboat navigation. Boats can not reach that point, however, during low-water seasons, the low-water depths of the river being as follows:

Three feet from the mouth to Blunts (Johnsons Landing), 25 miles; 2 feet from Blunts to mouth of Little Black River, 7 miles, and 16 inches from mouth of Little Black River to Pitmans Landing, 9 miles. From Pitmans Landing to Doniphan, 12 miles, the head of the work done by snag boats now, the low-water depths are about 12 inches.

The range between high and low water at Van Buren is about 16 feet, and this range does not vary much until below the mouth of Little Black River, when the range increases to 19 feet.

Practically nothing was done during the year, the only operations being those of working the *Riverside* (hand propelled) over the lower 12 miles of the river in July, 1906. Thirty snags were removed from the channel and 77 trees cut on caving banks.

*Commercial statistics.*

Year ending May 31—	Black River.		Current River.	
	Value.	Tons.	Value.	Tons.
1895 .....	\$1,085,415	132,433	\$362,447	31,205
1896 .....	891,437	111,278	227,291	29,867
1897 .....	1,704,799	111,611	581,523	17,078
1898 .....	788,640	115,612	306,216	52,417
1899 .....	529,336	83,404	239,869	43,050
1900 .....	966,961	129,698	578,834	65,043
1901 .....	989,635	185,714	234,555	64,102
1902 .....	919,767	166,213	165,766	37,185
1903 .....	695,649	138,181	142,899	45,309
1904 .....	1,092,648	191,285	139,119	55,573
1905 .....	1,004,299	144,065	409,297	74,048
1906 .....	625,985	139,384	152,216	47,704
1907 .....	692,968	107,914	226,655	48,486

Of the commerce reported this fiscal year 33 per cent of that on Black River and 40 per cent of that on Current River was rafted saw logs, railway ties, and lumber. Timbering and kindred industries produced the bulk of the steamboat commerce.

The balance available July 1, 1907, will be expended in maintenance of channel by snagging operations.

BLACK RIVER.

July 1, 1906, balance unexpended .....	\$5,926.08
Amount allotted from appropriation by river and harbor act approved March 2, 1907 .....	13,000.00
Receipts from sales .....	7.00
	18,933.08
June 30, 1907, amount expended during fiscal year, for maintenance of improvement .....	6,589.93
July 1, 1907, balance unexpended .....	12,343.15
July 1, 1907, outstanding liabilities .....	688.16
July 1, 1907, balance available .....	11,654.99

## CURRENT RIVER.

July 1, 1906, balance unexpended	\$1,314. 16
Amount allotted from appropriation by river and harbor act approved March 2, 1907	5,000. 00
	<hr/> 6,314. 16
June 30, 1907, amount expended during fiscal year, for maintenance of improvement	1,285. 01
	<hr/>
July 1, 1907, balance unexpended	5,029. 15
July 1, 1907, outstanding liabilities	4. 00
	<hr/>
July 1, 1907, balance available	5,025. 15

## CONSOLIDATED.

July 1, 1906, balance unexpended	\$7,240. 24
Amount appropriated by river and harbor act approved March 2, 1907	18,000. 00
Receipts from sales	7. 00
	<hr/> 25,247. 24
June 30, 1907, amount expended during fiscal year, for maintenance of improvement	7,874. 94
	<hr/>
July 1, 1907, balance unexpended	17,372. 30
July 1, 1907, outstanding liabilities	692. 16
	<hr/>
July 1, 1907, balance available	16,680. 14

(See Appendix X 6.)

7. *St. Francis and L'Anquille rivers, Arkansas.*—(a) *St. Francis River.*—In its original condition this stream was not navigable above Lesters Landing at any stage; between Lesters Landing and Marked Tree navigation was possible at high stages only, and below Marked Tree it was difficult at medium and lower stages and impossible at extreme low water.

The original project, adopted by act of March 3, 1871, contemplated improvement from the mouth to Wittsburg by snagging operations. For the period 1873–1882 the appropriations were made for this work in connection with White River, Arkansas. By act of June 14, 1880, appropriation was made for improving the river from Wittsburg to Lesters Landing, the project for the expenditure of this appropriation being to cut a channel through "The Lake" and clear the river of obstructions by snagging operations. Appropriation made by act of July 5, 1884, was the first separate appropriation for the entire river. The act did not state the limits within which it was to be applied. Under it snagging operations were carried on to the town of St. Francis, Ark., and several of the sloughs or side channels were closed. When the improvement of St. Francis River, Missouri, was begun (act of August 11, 1888), Kennett, Mo., was taken for the upper limit of this work, making the existing project—

removal of logs, drifts, and snags from the channel, and overhanging timber from the banks from the mouth to Kennett, Mo., and closing the chutes and sloughs in the Sunk Lands, so as to make the river navigable at high stages to Kennett, Mo., at medium stages to Marked Tree, and at low stages to a point 30 miles below Madison, Ark., the estimated cost being \$8,000 annually.

(b) *L'Anquille River.*—By acts of June 18, 1878, March 3, 1879, and June 14, 1880, a total of \$17,000 was appropriated for snagging operations on L'Anquille River to Marianna. This was finally

expended in fiscal year ending June 30, 1887. Act of June 13, 1902, revived this work and included it with St. Francis River.

There has been expended on these rivers to June 30, 1907, \$103,-084.93, which amount, however, does not include the expenditures on St. Francis River while it was combined with White River, as those expenditures can not be determined.

By the early operations the St. Francis River between Wittsburg and Lesters Landing was improved to such an extent that boats could reach the latter-named place on the same stage as they could the former. By subsequent operations the period of navigation below Wittsburg was lengthened about two months, and above Lesters Landing a fair high-water channel was made. The improvements thus made below Wittsburg have been maintained. No effort is being made to maintain those above Marked Tree, the commerce in that portion of the river not warranting any expenditures at this time. During periods of low water neither stream is navigable, there not being sufficient depth of water over the shoals. Marianna is the head of navigation on L'Anguille River. The head of navigation on St. Francis River is near Wappapello, Mo., about 100 miles above Kennett, Mo., the upper limit of the portion of the river covered by this project. Lying between Kennett, Mo., and Foot of Lake, 80 miles below, are the Sunken Lands of the St. Francis, one vast swamp, through which the river flows in several channels, none of which is well defined and all of which are more or less obstructed and frequently blocked. Lesters Landing is 34 miles above Foot of Lake and is the practicable head of navigation on the St. Francis River in Arkansas. Boats can pass between it and Kennett, Mo., only during high stages, and then only with great difficulty.

The range between high and low water of St. Francis River at Lesters Landing is about 3 feet. This increases to 16 feet at Marked Tree, and this range is probably the maximum that would exist at any point below there were it not for the backwater from the Mississippi River. At Madison the extreme range is about 33 feet, and at the mouth of the river it is about 55 feet.

Reference to examination and survey of these rivers with a view to improvement by means of locks and dams is given on page 410 of Annual Report for 1904. Reference to report of examination of St. Francis River from its mouth to St. Francis, Ark., will be found on page 460 of Annual Report for 1906.

The operations of this fiscal year were confined to care of plant, the appropriation of March 2, 1907, not being available until the snagging season for this year had passed.

*Commercial statistics, year ending May 31.*

Year.	Tons.	Value.	Year.	Tons.	Value.
1894.....	19,763	\$98,375	1901.....	57,102	\$272,609
1895.....	38,107	321,439	1902.....	85,881	269,190
1896.....	67,740	401,457	1903.....	88,085	294,495
1897.....	97,848	1,117,891	1904.....	119,172	423,469
1898.....	23,819	237,481	1905.....	142,098	590,560
1899.....	27,892	315,459	1906.....	137,319	472,257
1900.....	45,065	194,237	1907.....	151,015	838,397

Saw logs and rough lumber made up 96 per cent of the tonnage reported this year. Forty-five per cent of the tonnage was saw logs floated with the current.

The balance available July 1, 1907, will be expended in maintenance of channel by snagging operations.

July 1, 1906, balance unexpended-----	\$868. 71
Amount appropriated by river and harbor act approved March 2, 1907-----	12, 000. 00
	<hr/> 12, 868. 71
June 30, 1907, amount expended during fiscal year, for maintenance of improvement-----	716. 45
July 1, 1907, balance unexpended-----	12, 152. 26
July 1, 1907, outstanding liabilities-----	275. 21
	<hr/> 11, 877. 05
(See Appendix X 7.)	

EXAMINATION MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF  
MARCH 3, 1905.

Report dated October 9, 1906, required by the river and harbor act approved March 3, 1905, on preliminary examination of upper Cache River, Arkansas, from the lower line of Jackson County to the upper line of Greene County was submitted by the district officer and was reviewed by the Board of Engineers for Rivers and Harbors, pursuant to law. The report was transmitted to Congress and is printed in House Document No. 176, Fifty-ninth Congress, second session. The locality is not deemed worthy of improvement by the United States.

REMOVING SNAGS AND WRECKS FROM MISSISSIPPI RIVER; IM-  
PROVEMENT OF MISSISSIPPI RIVER BETWEEN OHIO AND  
MISSOURI RIVERS.

This district was in the charge of Maj. Thos. L. Casey, Corps of Engineers, to August 9, 1906, and of Col. Clinton B. Sears, Corps of Engineers, since that date. Division engineer, Lieut. Col. W. H. Bixby, Corps of Engineers, to August 9, 1906.

1. *Removing snags and wrecks from the Mississippi River below the mouth of the Missouri River.*—Before this work was begun the navigation of the river was seriously obstructed by numerous snags, logs, etc., which had lodged in the channel, and to which additions were made with each rise of the river. A large number of wrecked flatboats, barges, steamboats, and other river craft also obstructed the navigable channels, menacing life and property.

For the removal of these obstructions appropriations were made as early as 1824. The project adopted consisted of building boats suitable for removing snags, logs, drift heaps, wrecks, etc., and operating them whenever the stage of river was favorable and funds were available, and in cutting trees from caving banks to prevent their falling into the river and becoming obstructions to navigation.

The existing project is a continuation of the plan adopted in 1879, when the first specific appropriation for removing snags, wrecks, etc., from the Mississippi River was made by the river and harbor act

approved March 3, 1879. Specific appropriations or allotments were made for this work each year thereafter, except 1883, 1885, and 1887, but in 1888, by section 7 of the river and harbor act approved August 11, a continuous annual expenditure of \$100,000, or as much thereof as might be necessary, was authorized for the maintenance of this service, and this amount has been available each year since to the present time.

No modification of the project has been made since its adoption, the plan being continuous, new obstructions being brought down by each flood in the river, and so much of the continuous appropriation as may be required each year will be applied to their removal.

The amount expended upon this work prior to June 30, 1872, can not now be ascertained, for the reason that during that time and to March 3, 1879, appropriations were made in lump sums, principally under the titles of "Improvement of Mississippi, Missouri, and Arkansas rivers," to be applied to several streams as their needs or the terms of the laws required, and the available records do not show the amount applied to each stream.

The approximate amount expended from July 1, 1872, to June 30, 1880, was \$493,437.23, and the definitely known amount expended from July 1, 1880, to June 30, 1907, was \$2,006,067.47, making the total of approximate and known expenditures to date \$2,499,504.70.

From March 28, 1868, the earliest date of available record of work done, to June 30, 1907, 88,094 snags were pulled, 52 wrecks and 590 drift piles were removed, and 436,489 trees were cut, greatly improving the river and lessened the dangers of navigation.

Two steel-hull snag boats were engaged in removing the obstructions to navigation between the mouth of the Missouri River and Kennerville, La., a distance of about 1,240 miles. During the year 3,339 snags were pulled, 23 drift piles and 7 wrecks were removed, 2,772 trees were cut, and 21,815 miles patrolled.

For information as to the commerce benefited by this work, reference should be made to the commercial statistics in the report upon improving the Mississippi River between the Ohio and Missouri rivers and in the reports of the Mississippi River Commission and the district officers thereunder. The amount expended during the year was \$85,669.59.

(See Appendix Y 1.)

2. *Mississippi River between Ohio and Missouri rivers.*—In its original condition the navigable channel of this section of the Mississippi River had a natural depth in many places of only  $3\frac{1}{2}$  to 4 feet at low water. The channels were divided by islands and bars, which formed chutes and sloughs and secondary channels, through which a great deal of the volume of the flow was diverted, to the detriment of navigation.

The first effort to improve this condition was begun in 1872 and was continued for a number of years as appropriations were made, the works of improvement consisting of dikes and dams of brush and stone to confine the low-water volume in the vicinity to a single channel and of revetments to hold and preserve the banks where it was deemed necessary or advisable to do so.

The project followed in latter years and up to the present time has been that adopted in 1881, approved by letter of the Chief of Engineers dated March 31, 1881, contemplating the confinement of the flow of the river to a single channel having an approximate width below St. Louis of 2,500 feet at bank-full stage, the natural width in many cases being a mile or more at mean high water; this result to be sought by closing sloughs and secondary channels and by building out new banks where the natural width is excessive, using for the purpose permeable dikes or hurdles of piling to collect and hold the solid matter carried in suspension or rolled on the bottom by the river; the banks, both new and old, to be revetted or otherwise protected where necessary to secure permanency. Modifications of the project in the river and harbor acts of 1896 and 1902 provided that, pending the completion of the permanent improvement, the low-water channel be improved each season by the use of dredges and other temporary expedients. By report of a Board of Engineers in 1903 the cost of the work remaining to be done was estimated at \$20,000,000, with annual expenses of \$400,000 for maintenance, but it was hoped that the cost might be materially reduced by a more extensive use of dredging, which was made one of the recommendations.<sup>a</sup>

The river and harbor act of March 3, 1905, made a radical departure from the project of 1881, above outlined, confining the work of improvement to dredging and authorizing the construction of two additional hydraulic dredges of the most approved type, which are now in process of construction.

This change of plan threatened to put an end to the work of permanent improvement, but by joint resolution of Congress approved June 29, 1906, the Secretary of War was authorized, in his discretion, to expend any portion of the balance then remaining to the credit of this improvement for the repair or completion of improvements already under way or for the construction of other works in accordance with general plans already made or approved, provided that such expenditures should be made only for improvements useful for purposes of navigation.

The river and harbor act of March 2, 1907, reaffirmed dependence upon dredging as the principal means of improvement, and, as subsidiary thereto, provided also for the maintenance and repair of existing works of permanent improvement, and finally for the construction of similar works with any portion of the appropriation not necessary for the accomplishment of the purposes first named. The allotment, however, was reduced to about 40 per cent of that hitherto usual. Continuing contracts to the amount of \$750,000, yet to be appropriated, were authorized and the expenditure in one year limited to \$250,000 approximately.

Increase is not now recommended, as the amount fixed upon practically indicates the will of Congress until after report of the special survey, for which provision was separately made, having in view an examination and discussion of a plan to be recommended for the future improvement of this section of the river.

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<sup>a</sup> See Annual Report of the Chief of Engineers for 1904, p. 2144 et seq.

The object of the previous and present plans of improvement is to obtain and maintain a minimum depth at standard low water of 6 feet from the mouth of the Missouri to St. Louis and of 8 feet from St. Louis to the mouth of the Ohio.

The amount expended to June 30, 1907, was \$11,911,830.81, exclusive of \$180,000 allotted by acts to projects for improvement between the Illinois and Missouri rivers, including Alton Harbor.

The result of the expenditure of this amount has been the partial improvement of the entire extent of the river from St. Louis to Cairo.

The new appropriation asked for is the estimated expenditure for one year only, and should be increased by authorization under continuing contracts for other years by at least the same sum annually until the new plan is authorized by Congress.

It is proposed to expend the new appropriation asked for in dredging and in such temporary and permanent channel improvements as may be authorized by law.

The amount expended during the fiscal year ending June 30, 1907, was \$316,839.18, and includes \$105,468.48 expended for dredging. The total amount thus far expended for temporary channel improvements is \$930,067.78, much of which has been for plant that is now on hand and available for future work. The approximate value of this plant is \$211,236.72.

This improvement has probably had a beneficial influence on freight rates, as the rates to localities reached by water are well known to be lower than those remote from this advantage, but an accurate estimation of such effect is impracticable.

During the past year there was maintained a channel depth of 8 feet during the entire season unobstructed by ice.

The river at St. Louis reached a high-water stage of 26.3 feet above standard low water on January 23, 1907, and a low-water stage of 1 foot below standard low water on December 28, 1906.

With the present appliances and such others as are authorized for the temporary improvement of low-water channels it is expected that a navigable depth of about 8 feet can be maintained between St. Louis and Cairo during all stages of river open to navigation.

*Recapitulation of commercial statistics.*

	1903.	1904.	1905.	1906.
	<i>Tons.</i>	<i>Tons.</i>	<i>Tons.</i>	<i>Tons.</i>
Receipts and shipments at St. Louis .....	552,617	377,935	370,425	416,855
Transferred by ferries at St. Louis .....	6,328,154	6,680,109	6,684,949	7,374,978
Shipped from landings between St. Louis and Cairo...	43,867	43,672	69,729	62,238
Total .....	6,924,638	6,501,716	7,125,103	7,854,071



July 1, 1906, balance unexpended.....	\$642, 055. 45
Amount appropriated by river and harbor act approved March 2, 1907.....	250, 000. 00
June 30, 1907, miscellaneous receipts.....	2, 365. 33
	<hr/>
	894, 420. 78
June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$82, 161. 72
For maintenance of improvement.....	234, 677. 46
	<hr/>
	316, 839. 18
July 1, 1907, balance unexpended.....	577, 581. 60
July 1, 1907, outstanding liabilities.....	30, 982. 84
	<hr/>
July 1, 1907, balance available.....	546, 598. 76
	<hr/>
July 1, 1907, amount covered by uncompleted contracts.....	257, 443. 30
Amount (estimated) required for completion of existing project.....	18, 001, 654. 55
	<hr/>
Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement and for maintenance, in addition to the balance unexpended July 1, 1907.....	250, 000. 00
Submitted in compliance with requirements of sundry civil act of June 4, 1897.	
(See Appendix Y 2.)	

OPERATING SNAG BOATS AND DREDGE BOATS ON UPPER MISSISSIPPI RIVER; IMPROVEMENT OF MISSISSIPPI RIVER BETWEEN MOUTH OF MISSOURI RIVER AND ST. PAUL, MINNESOTA, AND OF HARBOR AT MOLINE, ILLINOIS; OPERATING AND CARE OF GALENA RIVER IMPROVEMENT, ILLINOIS, AND OF ILLINOIS AND MISSISSIPPI CANAL AROUND THE LOWER RAPIDS OF ROCK RIVER AT MILAN, ILLINOIS.

This district was in the charge of Maj. C. S. Riché, Corps of Engineers. Division engineer, Lieut. Col. W. H. Bixby, Corps of Engineers.

1. *Operating snag boats and dredge boats on upper Mississippi River.*—By the river and harbor act of August 11, 1888, provision was made for securing the uninterrupted work of snag boats and dredge boats on the upper Mississippi River under a permanent appropriation, the sum so expended not to exceed \$25,000 annually.

By river and harbor act of March 2, 1907, the annual appropriation for operating snag boats on the upper Mississippi River was made available for similar purposes on the Illinois River from its mouth to Copperas Creek.

During the past fiscal year the snag boat *Colonel A. Mackenzie* was employed from July 1 to November 8, 1906, and from April 23 to June 30, 1907, in removing snags and other obstructions and otherwise assisting the interests of navigation in the Mississippi River between Minneapolis and the mouth of Missouri River and in the Illinois River between its mouth and Copperas Creek.

U. S. dipper dredge *Phoenix* was engaged from August 6 to 21, 1906, in removing obstructions at the steamboat landings at Fulton and Davenport.

U. S. hydraulic dredge *Hecla* was employed August 3 to 8, 1906, in removing deposits at steamboat landing at Keokuk; August 9 to 22 on similar work at Hamburg, and October 15 to 27 in cutting through the bar at Curtis Point.

The total amount expended for snag-boat service to June 30, 1907, was \$999,584.

The total quantity of freight transported on the upper Mississippi River during the calendar year 1906 was about 3,847,319 tons, and the ton-miles 698,031,841; in 1905, 4,089,318 tons and 765,081,964 ton-miles.

The amount expended during the fiscal year ending June 30, 1907, was \$25,000.

(See Appendix Z 1.)

2. *Mississippi River between Missouri River and St. Paul, Minn.*—

Under this head is carried on the improvement of through navigation and also such special harbor or levee work as is provided for by Congress. Systematic work was begun in 1878, and such good results have been secured as to demonstrate that with a continuance of operations under liberal appropriations the low-water channel of the Mississippi River between St. Paul and the Missouri River can be made sufficiently deep, available, and permanent to satisfy the demands of commerce.

The original condition of the channel between the Missouri River and St. Paul was such that in low stages the larger boats were unable to proceed farther upstream than La Crosse or Winona, and in many seasons at points much lower down their progress was checked or seriously hindered.

The original project for the improvement, adopted in 1879, proposed the contraction of the channel or waterway by means of wing and closing dams to such an extent as, by means of the scour thereby caused, to afford a channel of sufficient width and of a depth of 4½ feet at low water, to be eventually increased to 6 feet by further contraction. For this project no estimate was ever made. There was expended on the improvement under the original project and the modified project (provisional) of 1897 to June 30, 1907, \$11,895,772.55, of which about \$690,000 was applied to maintenance. At that date and for many years previous the condition of the channel was such as to permit the passage of the largest river boats at very low stages to St. Paul. It should be noted that of the amount above stated \$1,043,000 has been expended for harbors and levees not connected with through-channel improvement.

The existing project for the purpose of ultimately securing and maintaining a depth of channel of 6 feet was adopted by Congress March 2, 1907, and is given in full, with detailed estimate, in House Document No. 341, Fifty-ninth Congress, second session. It provides for further contraction of the channel, for auxiliary dredging, for a lateral canal at Rock Island Rapids and deepening Des Moines Rapids Canal, for repairs to existing work, and for maintenance during construction. The estimate of cost is \$20,000,000, provided it be completed within twenty years, and for care and maintenance after completion \$300,000 per annum. The river and harbor act of March 2, 1907, authorized contracts for prosecuting this work to the amount of \$1,500,000, yet to be appropriated, and limited the cost of work for each year to \$500,000 for three years.

Nothing has been expended on the work of existing project up to June 30, 1907.

During the past year work has been carried on by hired labor and use of Government plant, as follows: At Beef Slough bar, near Alma, in vicinity of Blacksmith Slough and River Junction, in Guttenberg channel, at Parsons bar, Eagle Point and Rock Island Rapids, in vicinity of Curtis Point, Portage Island, and Piasa Island, and under formal contract in vicinity of Savanna. At all localities where work was performed good results were obtained.

With the expenditure during the past year an increased depth was obtained at several localities. Needed repairs were made to dams and shore protections that were broken, settled, or otherwise damaged.

The maximum draft that could be carried, June 30, 1907, from the Missouri River to St. Paul, 658 miles (which latter point is the upper end of this district, at mean low water, stage 1.5 above extreme low water), was, as nearly as could be ascertained, 4.5 feet. During the past year, on account of prevailing high stages of the river, there has at no point been less than 7 feet in the channel, except at the Des Moines Rapids Canal.

The navigation interests are important, especially those pertaining to logs and lumber. The amount of freight carried during the season of 1906 was about 3,847,319 tons, having an approximate valuation of \$34,364,979, the tonnage being about 6 per cent less and the valuation 7 per cent more than in 1905. The number of ton-miles was 698,031,841.

The amount estimated as a profitable expenditure is to be used in the continuation of improvement work in accordance with the 6-foot project adopted by Congress March 2, 1907, for the purpose of extension of benefits to navigation. It is the estimated expenditure for one year only.

An instance of the effect of river improvement and water competition on freight rates applying to that portion of the Mississippi River in question, taken from report of Upper Mississippi River Improvement Association of 1905, is here given:

*A comparison of freight rates between points having water competition and an inland point.*

From—	To—	Miles.	Route.	Classes.				
				1.	2.	3.	4.	5.
St. Louis .....	St. Paul .....	573	Rail ....	\$0.63	\$0.52	\$0.42	\$0.26	\$0.21
Do .....	do .....	729	Boat ....	.40	.34	.27	.17	.14
Do .....	Oklahoma .....	543	Rail ....	1.30	1.09	.97	.84	.67

Other instances collected by the office in 1906 regarding canned goods in boxes, a medium class of freight, are:

From—	To—	Miles.	Route.	Rate per hundred-weight.
Rock Island .....	La Crosse .....	213	Rail .....	<i>Cents.</i> 23.0
		219	Boat .....	15.0
Do .....	Burlington .....	83	Rail .....	11.6
		81	Boat .....	8.0

While it is not claimed that river improvements are solely responsible for the great differences in freight rates above shown, it is well known that wherever water competition exists, whether by river, canal, or lake, its effect on freight rates is always beneficial to the public, and that so long as the navigation of the Mississippi River is practicable and somewhat in proportion to the feasibility of that navigation, such benefits will accrue, even if but little river commerce is actually carried on.

It is noted that the rate charged by the railroads on both banks of the river on freight from St. Louis to St. Paul is about 50 per cent greater than that charged by steamboats and that the railroad rate to an inland point having no water competition, but at about the same distance, is more than 200 per cent greater.

The same ratio prevails for lesser distances.

A classification of the freight carried by steamboats in 1905 was found impracticable, but on the least favorable showing above given (fifth class) the saving was \$0.07 per 100 pounds for 600 miles, or \$0.00233 per ton-mile, which amounts in round numbers to \$1,600,000 for that year. It is to be remembered that benefit also accrues to the public in the reduction of rates on freight carried by rail, the amount of which freight, although not definitely known, is thought to be much greater than that carried by boats. Were the improvement of the river to be abandoned and no further navigation practicable, the loss to the public during each year, on the basis of the rates to inland points, would be several millions.

The continued prosecution of the improvement to a greater extent than in recent years seems advisable, in order that the condition of the river for through navigation be maintained and gradually improved. It is not anticipated that any further material reduction in freight rates on the adjacent railways will thus be had, but there would be danger that any lessened efficiency of the river for navigation would soon result in an increase in freight rates on adjacent railways, and the volume of freight that might thus be affected is so great that a very small increase on these rail rates would annually exceed in total amount the recent annual appropriations for the improvement of the portion of river in question.

For repairing, enlarging, and strengthening the Warsaw to Quincy levee and for protecting the bank of the river adjacent, there has been expended to June 30, 1906, \$101,428.03. This levee is 39 miles in length, running along the east bank of the Mississippi River, and was built by property owners. No work was done in 1906.

For constructing, repairing, and revetting the Flint Creek to Iowa River levee and for protecting adjacent river banks, there has been expended to June 30, 1906, \$299,556.48. This levee runs from a point about 7 miles up the Iowa River, down the west bank of that river and of the Mississippi River to Flint Creek, near Burlington, Iowa. No work was done during the year.

For dredging Quincy Bay there has been expended to June 30, 1907, \$129,481.36, and for Quincy Bay and bar at Quincy, \$26,156.37 additional. Between August 24 and October 12, 1906, suction dredge *Hecla* worked on the bar with good results.

For the construction of a harbor of refuge below Davenport, Iowa, there has been expended to June 30, 1906, \$13,046.80 for raising and

repairing the dam at the head of Rockingham Slough, dredging, sinking cribs, and driving piles. No work was done in 1906.

For channel at Clinton, Iowa, there has been expended to June 30, 1907, \$22,873.33. During the year two wing dams were built from the Illinois shore above Lyon's bridge.

For the channel and harbor at Hannibal, Mo., there has been expended to June 30, 1907, \$14,762.67. No work was done during the past year.

For the harbor at Muscatine, Iowa, there has been expended to June 30, 1907, \$35,543.92. Harbor lines were established during the year, and a small amount of dredging was done along the shore above the high bridge.

For the harbor of refuge at Pepin, Wis., on Lake Pepin, there has been expended to June 30, 1907, \$20,554.66. No work was done during the past year.

July 1, 1906, balance unexpended.....	\$432,845.97
Amount appropriated by river and harbor act approved March 2, 1907.....	500,000.00
	<hr/> 932,845.97
June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$189,415.79
For maintenance of improvement.....	30,000.00
	<hr/> 219,415.79
July 1, 1907, balance unexpended.....	713,430.18
July 1, 1907, outstanding liabilities.....	38,000.00
	<hr/> 675,430.18
July 1, 1907, balance available.....	675,430.18
Amount (estimated) required for completion of existing project..	<hr/> 19,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907.....	500,000.00
Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

(See Appendix Z 2.)

3. *Operating and care of Des Moines Rapids Canal and dry dock.*—During the past fiscal year the Des Moines Rapids Canal was open for navigation two hundred and forty-nine days, during which time there passed through it 999 steamboats and 144 barges, carrying 48,825 passengers, 13,489 tons of merchandise, and 12,271 bushels of grain. There also passed through the canal 7,358,000 feet B. M. of lumber, 6,700,000 feet of logs, 1,300,000 shingles, and 4,232,000 laths. This statement is about double that of the previous year, but is, however, small, on account of prevailing high stages of water, which permitted most of the rafts and many boats to pass over the rapids instead of through the canal.

The draft afforded by the canal is 5 feet at extreme low water, which may be increased to 6 at high stages. There are 3 locks, having an available length of 325 feet and width of 78.5 feet.

The dry dock was in constant use during the entire year.

The cost of operating and care of the canal is provided for by an indefinite appropriation made by act of July 5, 1884.

The expenditures during the year amounted to \$37,698.97.

(See Appendix Z 3.)

4. *Mississippi River at Moline, Ill.*—The river and harbor act of March 3, 1905, adopted a definite project for improving Mississippi River at Moline, Ill., by excavating a channel 250 feet wide and 4 feet deep at low water from the city of Moline, Ill., to the head of the so-called arsenal dike above the city, and a similar channel connecting with the main river by means of a lock and dam at the foot of Benhams Island opposite the city, at an estimated cost of \$386,000, and \$10,000 annually for operation, care, and maintenance.

The entire amount of the estimate has been appropriated.

No channel at present exists on the line of the proposed lock and its immediate approaches.

The amount expended to June 30, 1907, is \$235,352.29.

The lock is practically completed with the exception of the gates. The machinery for operating the gates and valves has been received, as also the lumber and metal fittings for the gates. The dam is nearly completed, and good progress has been made on the back fills and in the rock excavation of both approaches. Most of the work has been done during the past year, and it is expected to put the lock in operation before the season closes.

The amount now available will complete the project. For reference to the approved project, see Annual Report of the Chief of Engineers for 1905, page 429.

July 1, 1906, balance unexpended.....	\$193, 754. 95
Amount appropriated by sundry civil act approved March 4, 1907..	136, 000. 00
	<hr/>
	329, 754. 95
June 30, 1907, amount expended during fiscal year, for works of improvement .....	179, 107. 24
	<hr/>
July 1, 1907, balance unexpended.....	150, 647. 71
July 1, 1907, outstanding liabilities.....	31, 084. 18
	<hr/>
July 1, 1907, balance available.....	119, 563. 53
	<hr/>
July 1, 1907, amount covered by uncompleted contracts.....	41, 475. 13

(See Appendix Z 4.)

5. *Operating and care of Illinois and Mississippi Canal around the lower rapids of Rock River at Milan, Ill.*—This portion of the canal is  $4\frac{1}{2}$  miles in length, surmounting a fall of 18 feet, and was formally opened to navigation April 17, 1895. During the past fiscal year the canal was in use two hundred and forty-seven days, during which time there passed through it 1,243 boats and barges, carrying 3,472 tons of freight and 2,862 passengers.

The commercial traffic was about double that of the previous year.

The draft afforded by the canal is 7 feet. The locks, 3 in number, have a length of 170 feet between miter sills and a width of 35 feet.

The cost of operating and care of the canal is provided for by an indefinite appropriation made by act of July 5, 1884.

The amount expended during the year is \$8,423.46.

(See Appendix Z 5.)

6. *Improvement of Rock River pool, Illinois and Mississippi Canal.*—Under a project and an allotment of \$20,000 from the appropriation for construction of the canal work was carried on in the

reach of Rock River, extending from Lock 29 to Lock 35. This project, approved by the Engineer Department December 14, 1906, provides for a channel 80 feet wide and 5 feet deep at low water from Lock 29 to Lock 35 by means of rock excavation and ordinary dredging of sand and gravel. One steam-drill boat, 1 dipper dredge, and 1 suction dredge, with tenders, have been employed during the current season, with good results, between Lock 29 and the head of Mansills Island, and it is thought that the work proposed will be completed prior to the intended opening of the canal.

The amount expended during the year is \$9,886.73.

(See Appendix Z 6.)

7. *Operating and care of Galena River improvement, Illinois.*—This improvement, consisting of a lock and dam in the Galena River, was purchased by the United States in March, 1894, under provisions of the act of September 19, 1890, at a cost of \$100,000.

During the past fiscal year the lock was open for navigation two hundred and thirty-five days, in which time there passed through it 3,131 boats and barges, carrying 12,540 passengers and 4,128 tons of merchandise, which traffic was about equal to that of the previous year.

The draft that can be carried at extreme low water is 2 feet, as limited by the depth on the lower miter sill of the lock, which has an available length of 307 feet and width of 52 feet.

The cost of operating and care of the improvement is provided for under an indefinite appropriation made by act of July 5, 1884.

The amount expended during the year is \$2,805.06.

(See Appendix Z 7.)

PLAN AND ESTIMATE OF COST OF IMPROVEMENT OF MISSISSIPPI RIVER  
BETWEEN THE MISSOURI RIVER AND ST. PAUL, MINN., MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF MARCH 3, 1905.

Report dated October 1, 1906, required by the river and harbor act approved March 3, 1905, on *estimate of cost of securing a channel 6 feet deep in the Mississippi River between the Missouri River and St. Paul, Minn.*, was submitted by the district officer. The report was transmitted to Congress and printed in House Document No. 341, Fifty-ninth Congress, second session. The cost of this work, including work on the Rock Island and Des Moines rapids, is estimated at \$20,000,000.

RESERVOIRS AT HEADWATERS OF MISSISSIPPI RIVER; IMPROVEMENT OF MISSISSIPPI RIVER FROM ST. PAUL TO MINNEAPOLIS, MINNESOTA, OF RIVERS IN WISCONSIN AND MINNESOTA TRIBUTARY TO MISSISSIPPI RIVER, OF WARROAD HARBOR AND RIVER, MINNESOTA, AND OF RED RIVER OF THE NORTH, MINNESOTA AND NORTH DAKOTA; GAUGING MISSISSIPPI RIVER AT ST. PAUL, MINNESOTA.

This district was in the charge of Lieut. Col. Geo. McC. Derby, Corps of Engineers, until November 17, 1906, and in the temporary charge of Col. James B. Quinn, Corps of Engineers, from November 18, 1906, to June 7, 1907, and of Capt. Edward H. Schulz, Corps of Engineers, since June 8, 1907. Division engineer, Lieut. Col. W. H.

Bixby, Corps of Engineers, to November 17, 1906, and since June 8, 1907.

1. *Mississippi River between St. Paul and Minneapolis, Minn.*—This stretch of river may be divided into three sections—lower, middle, and upper. The lower section, extending from the Omaha Railroad bridge in St. Paul to the mouth of the Minnesota River, is navigable, in its natural condition and during low water, for boats drawing 3 feet of water. Its further improvement is not now required. The middle section, mouth of the Minnesota River to Minnehaha Creek, has a swift current and a narrow channel of about  $2\frac{1}{2}$  feet depth. It is possible for the smaller boats to navigate it, but upstream freighting upon it is impracticable. No provision has been made for the improvement of this section. The upper section, Minnehaha Creek to Washington Avenue Bridge, in Minneapolis, may be subdivided into two sections, the first extending from Minnehaha Creek to Lock No. 2 and the second from Lock No. 2 to Washington Avenue Bridge. The first subdivision of the upper section is very similar to the middle section; the second subdivision was originally a succession of shallow rapids, separated by deeper pools. The ruling low-water depth was about 2 feet, and the swift current precluded in low stages the upstream passage of boats drawing more than 12 to 15 inches. The risks run and the expenditure of power required to navigate this section effectually prevented its use even by small-draft boats.

The project is for the improvement of the upper section, and was submitted March 1, 1894. It called for the construction of two dams, with locks of the same dimensions as those of the Des Moines Rapids Canal, and with 5 feet on the lower miter sills at low water. The project was approved by Congress and construction work inaugurated by the river and harbor act of August 18, 1894, which provided for commencing the construction of Lock and Dam No. 2, located near Meekers Island. The river and harbor act approved March 3, 1899, authorized the completion of Lock and Dam No. 2, together with Lock and Dam No. 1, under continuing contracts or otherwise, at a total cost, for both locks and dams, of \$1,166,457. An increase in the limit of cost to \$1,466,000 was authorized by the river and harbor act approved March 3, 1905. This act authorized continuing contracts for the completion of the work in the sum of \$299,543, of which \$239,543 still remains to be appropriated.

The amount expended to June 30, 1907, was \$932,572.81, of which the sum of \$2,792.43 was for the repair of the west bear-trap sluice gate at Lock No. 2 and should be classed as maintenance.

During the year the sum of \$13.19 was received from the sale of condemned material and for blueprint copies of maps.

During the year the damaged floor of Lock No. 2 was removed and a new floor laid of large paving stones on gravel filling. The west bear-trap sluice gate at Lock No. 2 was examined and repaired. The interior of the gate was found to contain a deposit of river silt, gravel, and bark, which prevented it from going within 2 feet of its normal condition when down. Most of the rods attached to the holding-down chains were broken or badly bent. This was caused by the rods being prevented by the sediment from falling as intended, and when the



gate was lowered the rods were struck and bent over or broken off short. The sediment was removed and the rods were taken out and replaced with chains. On account of the danger of high water, the east gate was not examined, but it is undoubtedly in the same condition and will be repaired when the river has fallen sufficiently.

Excavation for land wall of the lock was resumed and at the end of the fiscal year 2,400 cubic yards of the wall had been put in.

Lock No. 2 is now open for navigation and vessels drawing 4 feet or less with sufficient power to stem the swift current below the lock are now able to reach the steamboat landing at Minneapolis at and above the 3-foot stage of the river maintained during the low-water season through the operation of the reservoirs at the headwaters of the Mississippi. On May 19, 1907, the *Itura*, of Minneapolis, was locked through, being the first power boat to go through the lock.

The usual variation of water surface at Lock No. 1 is 7 feet and the maximum 16 feet.

The head of navigation for large boats is now the mouth of the Minnesota River. Freight boats and raft boats can and do navigate this portion. The reach from the mouth of the Minnesota River to Minnehaha Creek, a distance of 3.4 miles, is available for light-draft excursion boats and is regularly used by them.

At the present time the principal commerce is the passage of logs, loose and rafted. During the calendar year 1906 75,000,000 feet B. M. of logs, approximately 300,000 tons, with an estimated value of \$900,000, was floated loose on the upper and middle sections and towed in rafts by steamboats over the lower section. The excursion business on the lower and middle sections amounts to about \$15,000 per annum.

The construction of the two locks and dams will develop a passenger traffic between St. Paul and Minneapolis, and it is expected to reduce the freight rate on flour and grain shipped from Minneapolis.

It is proposed to expend the amount estimated as a profitable expenditure during the fiscal year 1909 in the construction of a lock-tender's dwelling at Lock and Dam No. 2 and completing Lock and Dam No. 1.

By act approved June 25, 1906, Congress created a Commission to examine and report to the Secretary of War concerning the use by the United States of the waters of the Mississippi River flowing over the dams between St. Paul and Minneapolis, Minn. Lieut. Col. G. McC. Derby, Corps of Engineers; Capt. Amos W. Kimball, quartermaster, U. S. Army, and Chief Engineer Carl M. Green, U. S. Revenue-Cutter Service, were appointed members of the Commission. Owing to the inability of the members of the Commission to arrange a meeting, for various reasons, the Secretary of War designated Maj. W. V. Judson, Corps of Engineers, to serve in lieu of Lieut. Col. G. McC. Derby, Corps of Engineers, who was away on leave of absence; and J. E. Woodwell was designated by the Secretary of the Treasury to serve in lieu of Chief Engineer Carl M. Green. The recognized commission has had one meeting at St. Paul, but has not yet submitted its final report.

July 1, 1906, balance unexpended.....	\$315, 120. 02
Amount appropriated by sundry civil act approved March 4, 1907..	30, 000. 00
Amount derived from sales.....	13. 19

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345, 133. 21

June 30, 1907, amount expended during fiscal year :	
For works of improvement.....	\$48, 443. 40
For maintenance of improvement.....	2, 792. 43

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51, 235. 83

July 1, 1907, balance unexpended.....	293, 897. 38
July 1, 1907, outstanding liabilities.....	8, 870. 95

July 1, 1907, balance available.....	285, 026. 43
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July 1, 1907, amount covered by uncompleted contracts.....	5, 400. 00
Amount (estimated) required for completion of existing project.....	239, 543. 00

Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907.....	239, 543. 00
Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

(See Appendix A A 1.)

2. *Reservoirs at headwaters of Mississippi River, and Mississippi River between Brainerd and Grand Rapids, Minn.*—The original project, adopted January, 1880, calls for the construction of 41 reservoirs in Wisconsin and Minnesota to collect surplus water, principally from precipitation of winter, spring, and early summer, to be systematically released during the low-water season, so as to benefit navigation on the Mississippi River below. Estimated cost, exclusive of land and flowage easements, \$1,809,083. Dams have been constructed at Lake Winnibigoshish, Leech Lake, Pokegama Falls, Pine River, and Sandy Lake.

Reasons are given in the Annual Report of the Chief of Engineers for 1887, page 1681 et seq., for limiting the system at that time to the reservoirs then actually constructed.

The river and harbor act approved March 2, 1907, authorized the construction of a low reservoir at Gull Lake, Minnesota, project No. 1, which contemplates providing a reservoir to hold one year's supply of water—flowage line, 1,197 feet above sea level; capacity, 3,000,000,000 cubic feet—at an estimated cost of \$70,000, provided that the necessary land and flowage easements be furnished free of cost to the United States. The said act also authorized the reconstruction of Sandy Lake dam, without a lock for steamboats, at an estimated cost of \$75,000. As the present dam has a navigable lock in connection with it, the elimination of the lock in the proposed new structure caused considerable protest, as the present lock has been in constant use since the present structure was built. It is understood that an effort will be made at the next session of Congress to obtain an additional appropriation to provide for the reconstruction of the lock also. In my opinion the lock should be provided for, and would require an additional appropriation of \$50,000.

The amount expended to June 30, 1907, was \$1,387,441. During the year the sum of \$38.65 was received from sale of condemned material. The expenditures cover cost of construction of five dams and their operating machinery; the reconstruction of the dams at

Lake Winnibigoshish, Leech Lake, and Pokegama Falls; reconstruction of Pine River dam; superintendence and contingencies; certain awards for damages; purchase of lands and flowage easements; repairs and partial renewals; operating the dams up to February 1, 1895; and the removal of overhanging trees, snags, and other obstructions to navigation on the Mississippi River between Grand Rapids and Brainerd, Minn.

The expenditure has resulted in benefit during the low-water season to the navigable portions of the Mississippi River from Cass Lake, Minn., to Lake Pepin and below, and incidentally in the mitigation of the floods in the river above St. Paul.

The project at present is to replace the original timber structures by permanent dams of concrete or masonry; to construct a concrete dam at Gull Lake, Minnesota; to define by proper surveys the areas which are occupied for flowage or other purposes in the construction and operation of the reservoirs; and to acquire by purchase necessary rights not yet obtained over such areas. The project also includes the improvement of the Mississippi River between Brainerd and Grand Rapids, Minn., by the removal of snags and other obstructions.

For original plans and surveys, see Annual Reports of the Chief of Engineers for 1870, page 285; 1875, page 441; 1879, page 1206; 1881, pages 1761 and 2748; 1882, page 1830; 1885, page 1749; also report of Board of 1880, Annual Report of the Chief of Engineers for 1881, page 1763. Modifications, Annual Report of the Chief of Engineers for 1883, page 1472. Effects on low-water stages, Annual Reports of the Chief of Engineers for 1886, page 1503; 1887, page 1669. Board of 1887 disapproved extension to St. Croix, Chippewa, and Wisconsin rivers, Annual Report of the Chief of Engineers for 1887, page 1680. Description of dams, 1881, page 1763; 1883, page 1456; 1887, page 1667; 1901, page 2313. History, 1892, page 1824; 1901, page 2309. For regulations prescribed by the Secretary of War for operating, see page 1830, report for 1896. Crevasse, Pine River reservoir, page 1844, report for 1896, and page 1813, report for 1897. Second cut in natural embankment, Pine River reservoir, page 2184, report for 1899. Description of Lake Winnibigoshish dam, as reconstructed, page 2313, report for 1901.

During the year the reconstruction of Pine River dam was completed. Plans and specifications for the reconstruction of Sandy Lake dam, without a lock for steamboats, were prepared. Condemnation proceedings for the acquisition of the balance of the land and flowage easements required were inaugurated. Snags and sunken logs were removed from the channel, and overhanging trees and brush were cut along the banks of the Mississippi River between Grand Rapids and a point about 9 miles above Brainerd, Minn.

Before work was commenced on the Mississippi River between Brainerd and Grand Rapids, Minn., the channel was seriously obstructed by snags and sunken logs, and the banks were covered with overhanging trees and bushes, making steamboat navigation both difficult and dangerous. The work done during the past four years has resulted in a greatly improved channel.

The maximum draft that can be carried at low water depends upon the amount of water that is being released from the reservoirs. This amount varies with the requirements of navigation, but a depth of 4 feet could readily be maintained throughout the low-water season if it were necessary. The usual variation in the level of the water surface is about 10 feet. Cass Lake, Minn., is the head of navigation on the river, though it is interrupted by dams without locks at Minneapolis and several points above. There are no such obstructions between Brainerd and Grand Rapids, a distance of 182 miles.

There are five steamboats operating on the Mississippi River between Brainerd and Grand Rapids. During the year they carried about 5,550 passengers, about 11,900 tons of manufactured lumber, and about 14,700 tons of general merchandise. The estimated value of the last two items is \$1,078,050. About 410,000,000 feet B. M. of logs, about 1,435,000 tons, was floated down the river, their value being about \$4,920,000. There are no railroads paralleling the river on this stretch of 182 miles; settlers are mainly dependent upon the river as a means of transportation or are compelled to haul long distances by team.

The navigation interests most particularly benefited by the reservoir system, in addition to the above, are the steamboats operating on the Mississippi River from St. Paul down.

The effect of the project on freight rates is far-reaching as it makes steamboat transportation possible between Brainerd and Grand Rapids, where freight would otherwise have to be carried by wagon, and it makes it possible to maintain the river at St. Paul at or above a 3-foot stage when it would otherwise be liable to fall to zero or below. The railroad freight from St. Paul to St. Louis, 600 miles, is only 5 per cent higher than the rate from St. Paul to Chicago, 400 miles. Steamboat freight rates to common points below St. Paul are about one-third lower than those of the railroads.

Recent surveys having shown that owing to errors in the original surveys the United States failed in some cases to secure the flowage right on all the land affected by the reservoirs, fee title or flowage easements were obtained during the year on 91 tracts, aggregating 517 acres, at a cost of from \$3 to \$5 per acre for fee title, and \$1 to \$3 per acre for flowage easements. This, with 4,785 acres of public and State lands on which flowage easements have been reserved, makes a total of 8,006 acres on which fee title or flowage easement has been obtained since the completion of the resurvey of the reservoirs in 1903.

Of the expenditures during the year \$9,702.48 was expended in the reconstruction of Pine River dam; \$2,880.43 in the improvement of the Mississippi River between Brainerd and Grand Rapids; \$4,483.32 in the purchase of lands and easements required for flowage from the reservoirs, and \$3,690.45 for administration and office expenses.

July 1, 1906, balance unexpended.....	\$158,815.68
Amount appropriated by river and harbor act approved March 2, 1907.....	145,000.00
Amount derived from sales.....	38.65
	<hr/> 303,854.33
June 30, 1907, amount expended during fiscal year, for works of improvement.....	20,756.68
July 1, 1907, balance unexpended.....	283,097.65
July 1, 1907, outstanding liabilities.....	2,453.39
	<hr/> 280,644.26
(See Appendix A A 2.)	

3. *Operating and care of reservoirs at headwaters of Mississippi River.*—The river and harbor act of August 18, 1894, made applicable to the reservoirs at headwaters of Mississippi River, "so far as concerns their care, preservation, and maintenance," the provisions of the general appropriation for "Operating and care of canals and other works of navigation, indefinite," contained in section 4 of the river and harbor act of July 5, 1884. The first allotment was made January 25, 1895, and the expenses from February 1, 1895, have been paid from the indefinite appropriation.

The reservoir system was built by the Government primarily for the benefit of navigation on the Mississippi River and incidentally to mitigate its floods. The system is operated by impounding the waters in excess of the natural low-water flow at times when this excess is not needed by navigation and releasing during the low-water season of navigation such a volume of water as will maintain the gauge at St. Paul at a minimum height as much above low water as the available water in storage will permit. The district officer states that without the addition of stored waters from the reservoir system the river at St. Paul is liable to fall to a stage of 0.2 foot, as happened in July and August, 1894, or to minus 0.9, as happened in April, 1896, and would have happened also in August, 1894, but for the timely arrival of water from the reservoirs, whereas with judicious and economical use of the reservoir water it is quite practicable to keep the gauge at St. Paul from ever falling below 3 feet during the season of navigation. This is a very substantial benefit. On the 434 miles of river above St. Paul, where the stream is smaller, a still greater effect can be obtained.

The effect of the reservoirs in mitigating the floods of the upper Mississippi is equally pronounced. Were it not for holding back in the reservoirs the flood waters of a drainage basin 3,265 square miles in extent the flood height between Sandy River and Aitkin would often be several feet higher than it is during the spring and early summer.

Amount expended to June 30, 1907, \$234,756.46.

All five reservoirs have been operated during the entire year. During the year necessary repairs were made to the dams and quarters, and to the telephone lines between Winnibigoshish and Leech Lake dams and Bena, Minn., between Sandy Lake dam and McGregor, Minn., and between Pine River dam and Pequot, Minn.

For capacities of reservoirs, maps of region, and comparison of rainfall and run-off, see Annual Reports of the Chief of Engineers

for 1896, page 1841, and 1905, page 1678. For break in Pine River reservoir, see Annual Reports of the Chief of Engineers for 1896, page 1844, and for 1897, page 2144. For diagrams showing how much water had been stored each year in each reservoir, see Annual Report of the Chief of Engineers for 1900, Part 4, page 2798. For distribution of liabilities incurred during the fiscal years 1898 to 1905, see Annual Report of the Chief of Engineers for 1905, pages 1676-1677. For Report of Board of Engineers upon matters connected with the operation of the reservoirs, see Annual Report of the Chief of Engineers for 1906, Part 2, page 1443.

Leech Lake reservoir when full being about 4 feet below the level of Lake Winnibigoshish reservoir, a channel between the two would make it possible to draw off the surplus water from Lake Winnibigoshish reservoir, storing it in Leech Lake, to great advantage at times. Such a channel could be constructed at small expense. The efficiency of the reservoir system could also be greatly increased at small expense by dredging the channels above the dams and those connecting the various lakes that constitute the reservoirs. The aprons of the dams are now several feet below the level to which the water can be drawn down through the existing contracted channels.

(See Appendix A A 3.)

4. *St. Croix River, Wisconsin and Minnesota.*—Before the improvement was begun the low-water depth in the channel above Lake St. Croix was but 2 feet on many of the bars. In Lake St. Croix the channel over the Hudson and Catfish bars was narrow and tortuous.

The project adopted in 1875, and amended as to cost in 1882 and 1889, contemplated the removal of snags, bowlders, and bars, and the contraction of the low-water channel from Taylors Falls to the head of Lake St. Croix, and widening and straightening the channel where it is narrow and tortuous in Lake St. Croix by dredging and contraction works. The improvement of the harbor and water front of Stillwater, Minn., was added by the river and harbor act of June 3, 1896. The object of the improvement was to furnish a channel 3 feet deep from Taylors Falls to the confluence with the Mississippi River, 52.3 miles, and to better the harbor facilities at Stillwater. The last estimate placed the cost at \$136,700. The full amount of the estimate had been appropriated and expended by 1903 and the results sought had been achieved. Since that date but small appropriations have been available, which in the average have not been sufficient for the maintenance of the improvement. The channel above Stillwater has deteriorated to a depth of  $2\frac{1}{2}$  feet, and is also much obstructed with snags and sunken logs.

The amount expended to June 30, 1907, was \$143,533.34, of which the amount spent since 1900, \$12,123.84, was for maintenance only.

During September and October, 1906, the bar at Sweazys Landing was dredged for a distance of 143 feet, 60 feet wide and 4 feet deep at low water. The training dam at that point was repaired, about 300 feet of it being raised  $2\frac{1}{2}$  feet. In May and June, 1907, the entire dredging fleet and machinery was thoroughly overhauled and repaired at a cost of \$1,371.38. The fleet was taken up to Osceola, Wis., and dredging the bars in that vicinity was commenced just prior to the close of the fiscal year.

Regular appropriations of \$3,600 per annum are needed for the maintenance of this improvement.

The maximum draft that could be carried June 30, 1907, at low water was 3 feet at and below Stillwater. Taylors Falls, about 52 miles from its mouth, is the head of navigation on this stream, and the entire reach is navigable. The usual variation of level of water surface is about 6 feet.

The tonnage passing over the river was approximately 330,000 tons in loose logs and tows of lumber and log rafts during the season of 1906. A few steamboats made occasional trips from Stillwater to Taylors Falls during the season, and one is now running regularly between Taylors Falls and Osceola. Steamboat operations have been greatly interfered with heretofore by the running of loose logs in immense numbers and by cutting off the natural low-water flow of the river at dams controlled by the lumbermen. Logging operations are, however, now rapidly declining on this stream, and the principal obstruction to its use for general navigation is now the inadequate depth on the bars and the unsafe condition of the channel, due to snags and sunken logs. There are sixteen steamboats at Stillwater engaged in handling loose logs and rafting them to points below.

The effect of the project on freight rates is indirect, if any, for the river has practically been unnavigable of recent years above Stillwater and there are no freight boats plying on the river.

Reference to report on examination ordered by the river and harbor act of March 3, 1905, will be found in the Annual Report of the Chief of Engineers for 1906, Part 1, page 483.

July 1, 1906, balance unexpended.....	\$2, 880. 65
Amount appropriated by river and harbor act approved March 2, 1907..	4, 000. 00
	<hr/> 6, 880. 65
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	3, 048. 99
	<hr/>
July 1, 1907, balance unexpended.....	3, 831. 66
July 1, 1907, outstanding liabilities.....	656. 90
	<hr/>
July 1, 1907, balance available.....	3, 174. 76
(See Appendix A A 4.)	

5. *Minnesota River, Minnesota.*—Under original conditions the river was navigable at high stages of water between Mankato and the mouth, a distance of about 114 miles. Above Mankato it was navigable only during short periods of high water. Along its entire navigable portion it was obstructed with great numbers of snags, boulders, and overhanging trees.

The original project was adopted by Congress March 2, 1867, and provided for an open-channel improvement from Yellow Medicine River to the mouth, 237 miles, by removing snags and boulders; estimate of cost, \$117,000. This project was modified in 1893 to include the construction of a low-water dam across the mouth of the river at Pike Island and the dredging of the Fort Snelling chute at the head of Pike Island, through which the low-water discharge of the river is diverted by the dam. The dam does not affect high-water conditions, as it barely causes a ripple on the surface of the water at a

bank-full stage. Amount expended to June 30, 1907, \$135,354.23, of which \$3,854.98 was for maintenance of existing improvements.

Appropriations since 1896 have been very small and irregular and have all been applied to the maintenance of the improvement at the mouth of the river, for which purpose they have not been sufficient. The bar across the Fort Snelling chute re-forms whenever the Mississippi River is higher than the Minnesota and requires dredging every year to keep the channel in good order.

During the season of 1906 the river was at a fairly high stage, and the channel was therefore of sufficient depth at the mouth to permit the passage of boats without serious difficulty, and the small amount of dredging that could have been done with the funds available was unnecessary. A few overhanging trees and snags in the Fort Snelling chute were removed.

Regular appropriations of \$2,000 per annum are needed for the maintenance of this improvement.

The maximum draft that could be carried June 30, 1907, at low water is limited to about 2 feet on account of the undredged portion of the bar at the outlet. Immediately above this bar a depth of 6 feet exists to Shakopee, 24 miles, and 5 feet to Chaska, 29 miles from the mouth. Little Rapids, 37 miles from the mouth, may be considered the head of navigation at present, although at high stages navigation is possible to Le Sueur, 88 miles from the mouth.

No commerce now exists on this stream, except that of small pleasure launches and occasional excursion steamers, the river not having been maintained in such condition as to make other commerce possible.

Until a constant and sufficient low-water depth is assured, which can only be by such regularity in the appropriations as will permit annual dredging at the outlet, this stream can have no effect on commerce or freight rates, as vessels of commercial size can not ordinarily enter it.

For historical sketches see Annual Report of the Chief of Engineers for 1879 and 1894, pages 1182 and 1725, respectively.

July 1, 1906, balance unexpended.....	\$163. 64
Amount appropriated by river and harbor act approved March 2, 1907.....	2, 000. 00
	<hr/>
	2, 163. 64
June 30, 1907, amount expended during fiscal year, for maintenance of improvement .....	17. 87
	<hr/>
July 1, 1907, balance unexpended.....	2, 145. 77

(See Appendix A A 5.)

6. *Red River of the North, Minnesota and North Dakota.*—When the improvement of this river began the navigation of the reach from Breckenridge to Moorhead, 97 miles, was difficult at all stages and impossible at low water. The second reach, from Moorhead to Grand Forks, 155 miles, had a ruling depth at low water of 1.5 feet. The third reach, from Grand Forks to the boundary line of the United States, 143.5 miles, had a ruling low-water depth of 2 feet. The low-water navigation of Red Lake River was obstructed by bowlders between Thief River Falls and High Landing, a distance of 35 miles, and by a bad bar at the outlet of Red Lake.



The original estimated cost for improvement of Red River of the North was \$364,598.17, increased in 1883 to \$398,598.17. The estimate was revised in 1887 after Congress had substituted an open-channel improvement for lock and dam at Goose Rapids, and placed at \$252,598.37. An increase of the latter estimate was authorized May 8, 1893, to \$310,320. Congress in 1896 added \$5,000 to the estimate of cost by attaching the improvement of Red Lake River to the project. In 1899, \$4,000 of the \$10,000 authorized was allotted to Red Lake River, so that the present estimate of cost is \$319,320 for both rivers from the beginning of operations.

Red Lake River has been under improvement as part of the Red River of the North, in accordance with the river and harbor act of June 3, 1896, but owing to the limited amount of funds available nothing has been done since 1900, and in 1905 the floating plant at Thief River Falls was sold by authority of the Secretary of War.

The object of the improvement is to provide an open channel on the Red River of the North from Breckenridge to the northern boundary line, 395.5 miles, as follows:

1. Breckenridge to Moorhead (97 miles), a channel capable of being navigated during high and medium stages of water.
2. Moorhead to Grand Forks (155 miles), a channel 50 feet wide and 3 feet deep at low water.
3. Grand Forks to the northern boundary line (143.5 miles), a channel 60 feet wide and 4 feet deep at low water.

Also to provide a 3-foot open-channel improvement of Red Lake River and Red Lake from Thief River Falls to and including Red Lake, a total distance of 135 miles.

The total amount expended to June 30, 1907, including work on Red Lake River, was \$325,191.94, of which the expenditures since 1902, amounting to \$22,778.34, have been for maintenance only, the appropriations having been insufficient to carry on the original project. The sum of \$149.50 has been returned to the appropriation by the sale of condemned material.

During the year the dredging fleet at Grand Forks was repaired. The worst bars in the vicinity of Grand Forks were dredged to a low-water depth of 3 feet and width of 60 feet, over a stretch of about 18 miles, 18,900 cubic yards being removed. With the excavated material 3,855 linear feet of training dikes was formed, and 295 overhanging trees and snags and 3 bowlders were removed. In the spring of 1907 the dredging fleet and machinery were overhauled and repaired at a cost of \$509.03.

On June 30, 1907, the object of the improvement had not been attained on the first division of the Red River of the North, which has for some years been closed, by highway bridges, against all navigation. The desired results were obtained some years ago on all but 13 miles of the second division, but owing to shortage of funds, which has prevented sufficient dredging being done to maintain the improvement, the navigable depth on this division is now only 2 feet at low water. On the third division the object of the improvement was achieved in 1902, but for the reason given above the navigable depth is now only 3.5 feet at low water.

On Red Lake River work has been confined to the removal of snags, bowlders, and similar obstructions from the channel. Its navigable depth does not exceed 1.5 feet at low water.

Work on these streams has of late been confined to dredging the worst bars in the channel of Red River of the North in the vicinity of Grand Forks, N. Dak., and should be classed as maintenance only. It has been estimated that \$7,500 would be required annually for this work.

Belmont, N. Dak., about 35 miles by river south of Grand Forks, may be considered at present the head of navigation on Red River of the North, as above this point the river is obstructed by fixed bridges, which are, however, unauthorized by law. The distance from Belmont to the international boundary line is about 180 miles.

Red Lake River is navigable from Thief River Falls, Minn., to the outlet of Red Lake, about 35 miles, and Red Lake is also navigable. Below Thief River Falls the river is not now navigable, owing to the existence of numerous rapids and several dams.

The usual variation in the level of the water surface of Red River of the North is about 25 feet, with a maximum difference between extreme high and low water of 49 feet. On Red Lake River the usual variation is about 3.5 feet, with a maximum of 6 feet.

Navigation on the Red River of the North is at present confined to comparatively short reaches north and south of Grand Forks, and consists mainly in the transportation of wheat to Grand Forks by 2 steamboats and 12 barges. The tonnage during the years 1900-1906 was as follows: 1900, 20,000; 1901, 20,000; 1902, 20,086; 1903, 28,353; 1904, 19,295; 1905, 22,353; 1906, 13,965.

On Red Lake River 4 boats carried general merchandise and passengers to points on Red Lake, the total tonnage in 1906 being estimated at about 300; 625 passengers were carried. Fifty-five million feet B. M. of logs was run on the river during the year. Five steamboats are running on Red Lake, towing the above 55,000-000 feet of logs to the head of Red Lake River.

Apparently the Red River of the North has a noticeable effect on railroad freight rates, as the rate on wheat from Pembina to Duluth or Minneapolis is only 11 cents, whereas it is 14 cents from Rugby, which is about the same distance west of Grand Forks as Pembina is north of it. The river rates are from 70 to 50 per cent less than the railroad rates between common points.

For physical characteristics see Annual Reports of the Chief of Engineers for 1874, page 295; 1875, page 370; 1878, page 730; 1879, page 1192. For plans of improvements see Annual Reports of the Chief of Engineers for 1874, page 297; 1879, page 1191; 1881, page 1757. For revisions of projects see Annual Reports of the Chief of Engineers for 1883, page 1450; 1887, page 1712. For description of large landslide caused by Northern Pacific Railroad embankment, see Annual Report of the Chief of Engineers for 1898, page 1831. Reference to report on examination ordered by the river and harbor act of March 3, 1905, will be found in the Annual Report of the Chief of Engineers for 1906, Part 1, page 483.

July 1, 1906, balance unexpended.....	\$3,442. 11
Amount appropriated by river and harbor act approved March 2, 1907.....	15,000. 00
Amount derived from sales.....	149. 50
	18,591. 61
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	5,011. 05
July 1, 1907, balance unexpended.....	13,580. 56
July 1, 1907, outstanding liabilities.....	1,067. 41
July 1, 1907, balance available.....	12,513. 15

(See Appendix A A 6.)

7. *Warroad Harbor and Warroad River, Minnesota.*—The river and harbor act of 1899, as amended by the act approved June 6, 1900, appropriated \$3,000, or so much thereof as might be necessary, for improving the mouth of Warroad River, Minnesota. Under this appropriation no work was undertaken beyond making surveys, the balance of funds available having been held subject to action by Congress upon a preliminary report, plans, and estimate submitted June 6, 1900, and published in the Annual Report of the Chief of Engineers for 1901, page 2356. The estimate was \$45,000 for a dredging plant and two years' operating expenses. The river and harbor act of 1902 appropriated the amount estimated. The House Committee on Rivers and Harbors, by resolution, referred this project to the Board of Engineers for Rivers and Harbors, for report on the desirability of continuing the same or any modification thereof. The report of the Board was made December 22, 1903, and is printed in the Annual Report of the Chief of Engineers for 1904, page 2253.

An extension of the project was definitely specified by the river and harbor act of 1905, which appropriated \$35,000 for dredging a channel 100 feet wide and 7 feet deep from the inner end of the channel dredged in 1904 to the boat landing at Warroad, with a turning channel for boats at the inner harbor.

The outlet of Warroad River is the only natural harbor in the United States on the Lake of the Woods. Before dredging was commenced, the ruling depth of water on the bar at the mouth of the river was about 3½ feet, and on the outer bar 5 feet, at a stage of 7.2 feet on the lake gauge. The channel of the river to the steamboat landing was deep but tortuous.

The amount expended to June 30, 1907, was \$70,717.59, of which \$10,951.19 was for maintenance by redredging excavated channel.

Dredging was continued throughout the working season, and both the outer and inner bars were dredged. A minimum depth of 12 feet was secured on the bars and 9 feet in the inner channel at a stage of 7.2 feet on the lake gauge. A total of 75,039 cubic yards of material was removed, at a cost of about 9.94 cents per cubic yard. The dredging fleet and machinery were repaired at a cost of \$1,562.37.

On June 30, 1907, a channel 100 feet wide and the full depth required by the project had been dredged. The turning channel in the inner harbor had been completed. The maximum draft that can be carried over this completed portion is 8 feet at a stage of 7.2 feet on the lake gauge. This provides navigation facilities for any boat now operating on Lake of the Woods.

On account of the heavy windstorms which are prevalent on Lake of the Woods the dredged channel shoals up when operations are suspended. This necessitates redredging the excavated channel each season. The cost of this work of maintenance is approximately one-third of the amount expended each year.

The town of Warroad, now 7 years old, has a population of about 1,000, and the adjacent country is rapidly filling up with settlers. The imports of Warroad increased from 254 tons in 1900 to 4,000 tons in 1906. During the same period the exports increased from 1,215 tons to 28,684 tons.

Two steamboats, 4 sailing vessels, and 2 gasoline boats made regular trips to and from Warroad during the season of 1906, carrying 3,200 tons of freight and 3,260 passengers. There are now upward of 25 steamboats, from 10 to 500 tons capacity, navigating Lake of the Woods.

It is not apparent that this improvement can have any direct effect on railroad freight rates, as the common points of lake and railroad are not competitive, owing to the roundabout railroad routes. The steamboat rates to such common points are 75 to 50 per cent less than the railroad rates.

July 1, 1906, balance unexpended.....	\$23, 233. 60
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	10, 951. 19
July 1, 1907, balance unexpended.....	12, 282. 41
July 1, 1907, outstanding liabilities.....	2, 360. 21
July 1, 1907, balance available.....	9, 922. 20
July 1, 1907, amount covered by uncompleted contracts.....	1, 719. 00
Amount (estimated) required for completion of existing project....	13, 500. 00

(See Appendix A A 7.)

8. *Survey of Otter Tail Lake and Otter Tail River and Red Lake and Red Lake River, Minnesota, and of Big Stone Lake and Lake Traverse, Minnesota and South Dakota.*—The river and harbor act approved June 13, 1902, provided for the continuation of these surveys, which were ordered by Congress with a view to the construction of reservoirs for the improvement of the navigation of Red River of the North and Minnesota River.

Preliminary reports were submitted in April, 1900, and are printed in the Annual Report of the Chief of Engineers for 1900, pages 2828–2836. A final report was submitted August 11, 1903, and printed in the Annual Report of the Chief of Engineers for 1904, page 2260 et seq.

Amount expended on all projects to June 30, 1907, \$17,289.10.

During the year gaugings were made at Grand Forks, N. Dak., on Red River of the North and on Red Lake River, and at Wahpeton, N. Dak., on Red River of the North.

It is proposed to reserve the available funds for the purpose of making hydrological observations during the next flood affecting these localities.

July 1, 1906, balance unexpended.....	\$9, 179. 02
June 30, 1907, amount expended during fiscal year.....	968. 12
July 1, 1907, balance unexpended.....	8, 210. 90
July 1, 1907, outstanding liabilities.....	11. 00
July 1, 1907, balance available.....	8, 199. 90

(See Appendix A A 8.)

9. *Gauging Mississippi River at or near St. Paul, Minn.*—This work is provided for by allotment from the permanent annual appropriation of \$9,600 made by the river and harbor act of August 11, 1888, as amended by section 9 of the river and harbor act of June 13, 1902, for the purpose of securing the uninterrupted gauging of the waters of the Mississippi River and its tributaries. No gaugings were made until the fall of 1899. Since then gaugings have been made as frequently as the funds available would permit and the conditions justified the expenditure. For location of gauges, see map facing page 1832, Report of the Chief of Engineers for 1898.

Tables showing relation of rainfall to run-off in the Mississippi Valley above St. Paul are printed on page 2169, Report of the Chief of Engineers for 1897. The slope of the Mississippi River between Minneapolis and St. Paul is shown in the Report of the Chief of Engineers for 1900, page 2823.

Amount expended to June 30, 1907, \$6,510.88.

During the year the gauges between Minneapolis and the mouth of the Minnesota River were read from time to time, as required, and gaugings made in the river between Lock No. 2 and Lock No. 1.

July 2, 1906, allotment for fiscal year 1907.....	\$500. 00
July 1, 1907, balance unexpended.....	500. 00
July 1, 1907, outstanding liabilities.....	250. 92
July 1, 1907, balance returned to Treasury.....	249. 08

(See Appendix A A 9.)

10. *Survey of Lake Minnetonka, Minnesota.*—The river and harbor act approved March 3, 1905, provided for the survey of Lake Minnetonka for the purpose of charting only. An allotment of \$7,000 was made for the purpose.

Amount expended to June 30, 1907, \$5,718.73.

The survey has been completed, the map has been made, and an edition of 2,000 charts printed by photolithography.

The charts are sold at 50 cents each, or \$4.50 for 10 copies. At the end of the fiscal year 442 copies had been sold and 41 copies distributed to institutions and individuals for educational purposes. The proceeds of sales amounted to \$216.55 at the end of the fiscal year.

July 1, 1906, balance unexpended.....	\$1, 553. 44
June 30, 1907, proceeds of sales during fiscal year.....	216. 55
June 30, 1907, amount expended during fiscal year.....	1, 769. 99
July 1, 1907, balance unexpended.....	272. 17
July 1, 1907, balance unexpended.....	1, 497. 82

EXAMINATION MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF  
MARCH 3, 1905.

Report dated October 31, 1906, required by the river and harbor act approved March 3, 1905, on *preliminary examination of Big and Little Fork rivers, Minnesota*, was submitted by the district officer and was reviewed by the Board of Engineers for Rivers and Harbors pursuant to law. The report was transmitted to Congress and is printed in House Document No. 215, Fifty-ninth Congress, second session. The improvement of the locality by the United States is not considered advisable.

IMPROVEMENT OF THE MISSOURI RIVER, AND OF OSAGE AND GAS-  
CONADE RIVERS, MISSOURI.

This district was in the charge of Col. James B. Quinn, Corps of Engineers, to June 8, 1907, and of Capt. Edward H. Schulz, Corps of Engineers, since that date. Division engineer, Lieut. Col. W. H. Bixby, Corps of Engineers, since June 8, 1907.

1. *Missouri River.*—(a) *General improvement.*—The Missouri River has been navigated by steamboats since 1819; first boat to Council Bluffs, 1819; first to mouth of the Yellowstone, 1832; first to head of navigation, Fort Benton, Mont., 1859. The length of navigable river from Fort Benton to mouth is 2,284.8 miles. Some portions of the river above the Great Falls are also navigable.

No project for the improvement of the river as a whole has been adopted.

Government work on the river in the matter of removal of snags began as early as 1838 and continued thereafter, under annual appropriations (for the most part made jointly for the Ohio, Mississippi, Missouri, and sometimes the Arkansas rivers), with occasional intermissions, for the next forty years. Prior to 1878 one or two small appropriations had been made for general improvement, but it was with the act of June 18 of the latter year that appropriations began on a large scale.

The work prior to 1884 was carried on under separate districts. From 1884 to 1890 the work on the entire river was under the Missouri River Commission. After 1890 that portion above and including Sioux City, Iowa, was under a separate district until 1902. Since the discontinuance of the Missouri River Commission the works on the entire river have been consolidated under one district.

The greater part of the work on the portion of the river below Sioux City has been done by the Missouri River Commission, reporting to the Chief of Engineers. The Commission was constituted by act of Congress of July 5, 1884, and was abolished by the river and harbor act of June 13, 1902.

On the portion of the river above Sioux City the work has been done under the immediate charge of officers of the Corps of Engineers, except during the period from 1884 to 1890, when it was in charge of the Missouri River Commission. The effort of the Commission in its work below Sioux City was to accomplish a continuous, progressive control of the river, contracting it where necessary, giving the channel proper direction, and securely holding it in place.

Work in this direction was done in the vicinity of Kansas City and on the first reach of the river, which extends from near Jefferson City to the mouth. On 45 miles of this reach a continuous channel of not less than 6 feet in depth at low water was obtained on what was originally one of the worst parts of the river, in the vicinity of the mouth of the Osage. In addition to forming a channel, much new land was formed and much land protected from destruction by the river. The greater part of the funds appropriated for expenditure under the direction of the Commission was not applicable to the comprehensive plan of improvement adopted, and about one-third of it was diverted to work at separate localities.

A condensed description of the works on the river executed under the supervision of the Missouri River Commission is given in the Commission's last annual report (Annual Report of the Chief of Engineer's for 1902, Supplement).

On the upper portion of the river the work originally consisted mainly in improving the shoals and rapids on the so-called "Rocky River" from Fort Benton downstream for 150 miles. In recent years it has largely been limited to channel regulation and bank protection at the following points: Bismarck, N. Dak.; Pierre, Yankton, and Elk Point, S. Dak., and Sioux City, Iowa. Two ice harbors have been established, one at Rockhaven, N. Dak., the other in the mouth of the Big Sioux River, just above Sioux City.

Works of channel regulation have also been built in the Long Pool, or the reach of the river from the crest of the Great Falls to Cascade, and a small amount of open-river work in the steeper stretch from Cascade to Stubbs Ferry.

A condensed description of the work above the Great Falls will be found in the Annual Report of the Chief of Engineers for 1899, pages 385-386, and in later annual reports; and of the work on the river between Fort Benton and Sioux City in the Annual Report of the Chief of Engineers for 1902, pages 382-385.

A complete survey of the river has also been made, in part by the Commission and in part by officers in charge of the districts on the upper portions of the river.

In addition to the foregoing work a fleet of snag boats has been in operation clearing the channel of snags and other obstructions on the portion of the river where boats have been running. This work is considered to be directly beneficial to navigation.

The total of appropriations for the river, and of receipts from other sources, from the mouth to Sioux City, including snagging, beginning with the act of June 18, 1878, is \$9,332,463.13.

The total of the appropriations and of receipts from other sources for improvements of the upper river, including snagging, beginning with the act of August 14, 1876, is \$2,283,708.70.

The total expenditures for all purposes have been \$11,191,045.28. The result of these expenditures has been to demonstrate the possibility of regulating the river in such manner as to make it navigable for a channel of commerce; that the cost of such regulation would be very great, and that no permanent good to navigation can be accomplished by appropriations for specific localities not so connected as to form part of the systematically improved reaches. The result of the expenditures at separated localities has been beneficial locally by protecting the banks and in this manner preserving private property

from the ravages of the river, but has given little, if any, encouragement to through navigation.

During the past year work has been in the main confined to repair work and snagging.

Some revetment work was done at Wilhoite Bend by private interests, and the use of Government plant was loaned them under authority from the War Department.

An ice gorge near Vermilion was also relieved under a special appropriation of Congress.

At the localities under improvement an effort has been made to maintain the existing and prevailing depth of channel. The precise increase in depth and width of channel has not been determined, as no surveys were made. The least depth at mean low water over the shoalest part at the localities under improvement is not less than 6 feet. The usual variation of level of water is about 8 feet.

The river formerly carried an active commerce, which has been entirely diverted to other channels. This commerce now shows healthy signs of reviving.

(b) *Snagging*.—The removal of snags has formed a part of the scheme for improving both the lower and upper river since the work of improvement began. As snags form the most dangerous obstacle to navigation on this stream, their removal has been one of the most efficacious aids to its navigation. At present one snag boat on each division of the river regularly operates over such portions as are used by commercial vessels.

The work of the past fiscal year has consisted mainly in repair work and snagging carried on with small remaining balances from the appropriation of March 3, 1905. Work has also begun under the appropriation act of March 2, 1907, which provides that the amounts appropriated shall be applied in the first instance to the purpose of clearing the river of snags with a view to navigation, and that no part of such amount shall be applied for revetment or protection of banks of the stream unless such revetment or protection is directly and necessarily required for purposes of navigation.

Projects have been approved for the expenditure of these sums and work has begun in accordance therewith.

*Amount of freight carried on the Missouri River from mouth to Sioux City, Iowa.*

Calendar year—	Tons.	Calendar year—	Tons.
1897 -----	391, 029	1902 -----	410, 527
1898 -----	319, 793	1903 -----	750, 291
1899 -----	263, 114	1904 -----	455, 000
1900 -----	277, 306	1905 -----	343, 435
1901 -----	569, 666	1906 -----	573, 348

*Amount of freight carried on the Missouri River above Sioux City, Iowa.*

Calendar year—	Tons.	Calendar year—	Tons.
1887 -----	13, 961	1897 -----	17, 105
1888 -----	12, 895	1898 -----	26, 896
1889 -----	16, 723	1899 -----	23, 041
1890 -----	14, 072	1900 -----	27, 179
1891 -----	14, 211	1901 -----	37, 340
1892 -----	17, 292	1902 -----	31, 070
1893 -----	19, 481	1903 -----	37, 994
1894 -----	37, 936	1904 -----	28, 951
1895 -----	21, 264	1905 -----	52, 956
1896 -----	10, 368	1906 -----	43, 987



## UPPER RIVER.

July 1, 1906, balance unexpended-----	\$15,208.26
Amount appropriated by river and harbor act approved March 2, 1907-----	100,000.00
Amount appropriated by deficiency act of March 4, 1907-----	5,000.00
Amount received from sale of property-----	554.99
	<hr/>
	120,763.25
June 30, 1907, amount expended during fiscal year:	
For works of improvement-----	\$370.85
For maintenance of improvement-----	12,993.00
	<hr/>
	13,363.85
July 1, 1907, balance unexpended-----	107,399.40
July 1, 1907, outstanding liabilities-----	6,964.49
	<hr/>
July 1, 1907, balance available-----	100,434.91
	<hr/>
Amount (estimated) required for completion of existing project----	Indefinite.

## LOWER RIVER.

July 1, 1906, balance unexpended-----	\$55,320.15
Amount appropriated by river and harbor act approved March 2, 1907-----	300,000.00
Amount received from sale of property-----	2,328.57
Amount received by transfer-----	8.33
	<hr/>
	357,657.05
June 30, 1907, amount expended during fiscal year, for maintenance of improvement-----	40,429.90
	<hr/>
July 1, 1907, balance unexpended-----	317,227.15
July 1, 1907, outstanding liabilities-----	29,101.44
	<hr/>
July 1, 1907, balance available-----	288,125.71
	<hr/>
Amount (estimated) required for completion of existing project----	Indefinite.
(See Appendix B B 1.)	

2. *Osage River, Missouri.*—A history of the work of improvement on this river, from the adoption of the original project in 1871 to the end of the fiscal year 1900, was published in the Annual Report of the Chief of Engineers for 1900, page 4944.

The work has been carried on under two projects—that of open-channel improvement, by the construction of cross and wing dams, in addition to dredging and removal of obstructions to navigation, such as snags, etc., and the construction of a lock and dam 7 miles above the mouth of the river.

The removal of obstructions under the first project contemplates only temporary relief. The obstructions are constantly forming anew, and while the cross and wing dams have a degree of permanency, they must receive frequent repair and extension to keep up their efficiency. No definite time, therefore, can be fixed for its completion and no estimate made of its ultimate cost. The improvement must be a continuous one, and the annual estimates must depend upon conditions as they arise.

The total of the appropriations and of receipts from other sources for improvement of the Osage River, beginning with the act of August 18, 1894, is \$561,553.45.

The amount expended by the General Government upon both projects up to June 30, 1907, is \$453,574.35.

By the act of March 2, 1907, the sum of \$78,000 was appropriated for continuing construction of Lock and Dam No. 1, with authority for contracts to additional amount of \$160,000 (yet to be appropriated) for completion of the project.

In addition to the above, \$10,000 was allotted by the Secretary of War from emergency appropriation act of March 3, 1905, and \$10,000 from the appropriation of June 13, 1902.

During the past year work has consisted of caring for the plant and property and additional protection to the lock and pier No. 1. A project was adopted for completion of the dam at a cost of \$228,000. The assembling of materials for actual work is now under way.

The head of navigation is Warsaw, Mo., and the length of the navigable portion of the stream is 171.5 miles.

*Amount of freight carried on the Osage River.*

Calendar year—	Tons.	Calendar year—	Tons.
1895-----	76,706	1901-----	72,339
1896-----	72,393	1902-----	95,194
1897-----	71,247	1903-----	38,501
1898-----	84,286	1904-----	35,746
1899-----	76,702	1905-----	8,678
1900-----	96,144	1906-----	20,506

July 1, 1906, balance unexpended-----	\$28,960.24
Amount allotted from emergency appropriation, act March 3, 1905--	10,000.00
Amount allotted from appropriation, act June 13, 1902-----	10,000.00
Amount appropriated by river and harbor act approved March 2, 1907-----	78,000.00
Amount received from sale of property-----	316.00

	127,276.24
June 30, 1907, amount expended during fiscal year, for maintenance of improvement-----	19,497.14

July 1, 1907, balance unexpended-----	107,779.10
July 1, 1907, outstanding liabilities-----	4,824.50

July 1, 1907, balance available-----	103,454.60
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Amount (estimated) required for completion of existing project----	<u><u>\$160,000.00</u></u>
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{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907-----	<u><u>\$160,000.00</u></u>
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

(See Appendix B B 2.)

3. *Gasconade River, Missouri.*—The project for the improvement of this stream, adopted in 1880, consisted in the removal of snags and logs from the channel and of leaning timber from the banks of the river, where necessary, and the construction of wing dams and training walls to concentrate the flow of water upon the shoals to increase the depth over them.

From the nature of the project, which contemplates only temporary relief from year to year and the removal of obstructions which are constantly forming anew, no definite time can be fixed for its completion and no estimate made of its ultimate cost. The improvement must be continuous, and the annual estimates must depend upon conditions as they arise.

During the past season the boating channel was cleared of snags and wreck heaps and all overhanging trees were trimmed or felled.

The total of the appropriations and of receipts from other sources for the improvement of Gasconade River, beginning with the act of June 14, 1880, is \$111,724.31.

The amount expended under the project to June 30, 1907, is \$101,705.61.

The act of March 2, 1907, appropriated the sum of \$10,000 for continuing improvement of this river. A project for the expenditure of this money was approved and work carried on in accordance therewith.

The head of navigation is Arlington, Mo., and the number of navigable miles is 107.

*Amount of freight carried on the Gasconade River.*

Calendar year—	Tons.	Calendar year—	Tons.
1895	47,544	1901	19,460
1896	46,294	1902	44,380
1897	30,515	1903	10,788
1898	30,981	1904	14,791
1899	24,259	1905	29,837
1900	51,580	1906	27,604

July 1, 1906, balance unexpended	\$9,802.27
Amount appropriated by river and harbor act approved March 2, 1907	10,000.00
Amount received from sale of property	124.31

19,926.58

June 30, 1907, amount expended during fiscal year:	
For works of improvement	\$6,007.88
For maintenance of improvement	4,000.00
	10,007.88

July 1, 1907, balance unexpended	9,918.70
July 1, 1907, outstanding liabilities	1,341.72
July 1, 1907, balance available	8,576.98

Amount (estimated) required for completion of existing project..... Indefinite.

(See Appendix B B 3.)

IMPROVEMENT OF CUMBERLAND RIVER, TENNESSEE AND KENTUCKY, AND OF CANEY FORK, OBION, AND FORKED DEER RIVERS, TENNESSEE.

This district was in the charge of Maj. H. C. Newcomer, Corps of Engineers, until February 25, 1907, with First Lieut. W. G. Caples, Corps of Engineers, under his immediate orders; in the temporary charge of Lieutenant Caples from that date to June 18, 1907; and since the latter date in the charge of Maj. Wm. W. Harts, Corps of Engineers, with Lieutenant Caples on duty under his orders. Division engineer, Lieut. Col. Clinton B. Sears, Corps of Engineers, to July 16, 1906, and Col. E. H. Ruffner, Corps of Engineers, since that date.

1. *Obion and Forked Deer rivers, Tennessee.*—The river and harbor act of June 13, 1902, authorized the joint improvement of the Obion and Forked Deer rivers.

(a) *Obion River*.—This stream is situated in northwestern Tennessee. It is formed by the junction of its North and South forks about 6 miles northeast of Obion, which is considered the head of navigation, and it flows in a general southwesterly direction about 75 miles, entering the Mississippi River some 5 miles below the Missouri and Arkansas State line.

In its original condition the obstructions on this river were almost wholly drift, snags, and overhanging trees, which made navigation difficult and uncertain.

The original project was based on a survey made in 1891, and was adopted by the river and harbor act of July 13, 1892. The scope of the work was to obtain 3-foot navigation at low water by means of open-channel work, at an estimated cost of \$50,000. After an expenditure of \$15,795.01 this project was modified in June, 1897, to one for maintenance, so as to keep the river free from such obstructions as would prevent navigation at medium and high stages, at an estimated annual cost of \$2,500.

In 1903 the annual expenditure recommended for maintenance of the Obion and Forked Deer rivers was reduced from \$4,500 to \$2,250. (See Annual Report for 1904, p. 2351.)

Appropriations and allotments aggregating \$29,400 have been made for the Obion River, of which \$11,357.49 has been expended under the present project to June 30, 1907.

The expenditures have resulted in temporary improvements to the channel, lessening the dangers to navigation at medium and higher stages from Obion, Tenn., to mouth of river. The navigability of the Obion River depends largely on the stage of water in the Mississippi. Navigation is not practicable at low stages.

For the calendar year ending December 31, 1906, the reported commerce on this stream amounted to 12,358 tons, having an estimated value of about \$92,919, consisting almost wholly of timber products. Passengers carried, 1,750.

For additional details of the Obion River, see the account of its survey in the Annual Report of 1891, page 2292.

The effect of the improvement on freight rates is not known.

July 1, 1906, balance unexpended.....	\$695. 15
Amount allotted from appropriation by river and harbor act approved	
March 2, 1907.....	1,700. 00
	<hr/> 2,395. 15
June 30, 1907, amount expended during fiscal year, for maintenance of improvement .....	147. 65
July 1, 1907, balance unexpended.....	2,247. 50
July 1, 1907, outstanding liabilities.....	13. 00
July 1, 1907, balance available.....	<hr/> 2,234. 50

(b) *Forked Deer River*.—This stream is formed by the junction of its North and South forks about 8 miles southwest of Dyersburg, and flows thence in a general southwesterly direction about 21 miles, entering the Obion River about 3½ miles from the Mississippi. Dyersburg is considered the head of navigation on the North Fork. Jackson, Tenn., was formerly considered the head of navigation on the South

Fork, but in recent years navigation appears to have been limited to the lower portion of this stream.

In their original condition the main stream and its branches, the North Fork and South Fork, were greatly obstructed by snags and drift. The original project may be said to have been adopted by the river and harbor act of August 2, 1882, and was based on a report of an examination of South Fork, dated December 16, 1880. This project was subsequently modified by extension to include the North Fork and main stream until appropriations aggregating \$25,000 were made and expended. The operations proposed were open-channel work, by which it was sought to maintain a satisfactory channel all the year round. This project was set aside in view of the fact that the result aimed at could not be accomplished by this method.

The present project for maintenance, based on the provisions of the act of March 3, 1899, provides for the removal of surface obstructions from the Forked Deer River and its navigable branches (North and South forks), at an estimated annual cost of \$2,000 up to 1903, when the annual expenditure recommended for maintenance of both the Obion and Forked Deer rivers was reduced from \$4,500 to \$2,250. (See Annual Report for 1904, p. 2351.) Under this project appropriations and allotments aggregating \$12,600 have been made, of which \$10,883.79 has been expended to June 30, 1907. The expenditures have resulted in temporary improvements to the channed, lessening the dangers to navigation at medium and higher stages. The navigability of the Forked Deer River depends largely upon the stage of water in the Mississippi. Navigation is not practicable at low stages.

For the calendar year ending December 31, 1906, the reported commerce on this stream amounted to 9,746 tons, having an estimated value of about \$105,059, and consisting almost wholly of timber products; passengers carried, 1,800.

For list of sundry examinations and surveys of Forked Deer and navigable branches, see Report of Chief of Engineers for 1899, page 396. For report of latest examination of Obion and Forked Deer rivers, see Report of Chief of Engineers for 1904, page 2351 et seq.

The effect of the improvement on freight rates is not known.

July 1, 1906, balance unexpended.....	\$563. 35
Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	1, 300. 00
	<hr/> 1, 863. 35
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	147. 14
	<hr/>
July 1, 1907, balance unexpended.....	1, 716. 21
July 1, 1907, outstanding liabilities.....	11. 50
	<hr/>
July 1, 1907, balance available.....	1, 704. 71

## CONSOLIDATED.

July 1, 1906, balance unexpended-----	\$1,258.50
Amount appropriated by river and harbor act approved March 2, 1907-----	3,000.00
	<hr/> 4,258.50
June 30, 1907, amount expended during fiscal year, for maintenance of improvement-----	294.79
	<hr/>
July 1, 1907, balance unexpended-----	3,963.71
July 1, 1907, outstanding liabilities-----	24.50
	<hr/>
July 1, 1907, balance available-----	3,939.21
(See Appendix C C 1.)	

2. *Cumberland River, Tennessee and Kentucky.*—The Cumberland River rises in eastern Kentucky, on the western slope of the Cumberland Mountains, flows in a tortuous course of about 688 miles through eastern Kentucky, middle Tennessee, and western Kentucky, and discharges into the Ohio River near Smithland, Ky. From Burnside, Ky., the head of steamboat navigation, to Smithland, Ky., the distance is 518 miles by the river, 203 miles being in the State of Kentucky and 315 miles in the State of Tennessee.

(a) *Below Nashville (193 miles).*—From 1830 to 1840 the legislatures of Tennessee and Kentucky made several appropriations for the improvement of the navigation of the Cumberland River, but little benefit to the general condition of the river seems to have been accomplished. The Cumberland Navigation Company was incorporated by the State of Tennessee in 1846 for improving the "navigation of the Cumberland River below the town of Nashville by means of a system of locks and dams," but nothing effective was done to carry out the proposed improvement.

In its original condition this section of the river was considerably obstructed by rocky ledges, conglomerate, gravel and sand bars, snags, and other surface obstructions, on account of which navigation was rendered very uncertain.

From July 17, 1832, to July 7, 1838, Congress made five appropriations for improving the Cumberland River, Tennessee and Kentucky, aggregating \$155,000, \$20,000 of which was to be expended below Nashville and \$135,000 on the river generally, but all the appropriations for the above period were expended below Nashville, to improve the worst localities.

Between 1838 and 1871 no appropriations for this river were made. The original project (open-channel work), which provided specifically for operations on this section, was adopted by the river and harbor act of March 3, 1871, based on project submitted January 20, 1871. The work proposed was as follows: To excavate the bars and rock ledges to get an additional depth of water, to contract the waterways in places to get the requisite depth, to remove snags and bowlders from the main channel, and to restrain tributary streams in well-determined channels at their junction with the river.

To increase the depth of water at the shoals in Kentucky chute at the junction of the Cumberland with the Ohio River, a Board of

Engineer officers in 1888 recommended the construction of a dike near Smithland, Ky., at an estimated cost of \$129,600. The river and harbor act of September 19, 1890, allotted \$30,000 from the appropriation for improving Cumberland River below Nashville, to be expended in improving the mouth of the river, as recommended.

Appropriations aggregating \$305,000 were made and expended, thus completing the above project. The expenditures under the old project have resulted in lengthening the season of navigation by giving an increased depth at low water combined with greater security in the passage of obstructions.

The present project for improving the Cumberland River below Nashville was adopted July 13, 1892, by river and harbor act of that date. It contemplates the extension of the lock and dam system of the upper river over a considerable portion of the river below Nashville by the construction of 7 locks and dams, commencing at or near Harpeth shoal (Lock A) and ending at Big Eddy shoal (Lock G); the locks to be 52 feet wide and 280 feet long, with lifts varying from  $8\frac{1}{2}$  to  $11\frac{1}{2}$  feet and aggregating some 70 feet. The project also includes the improvement of the Kentucky chute, at the mouth of the river, as recommended by the Board of Engineer officers in 1888, the necessary channel work below Lock G, and the removal of surface obstructions, snags, logs, etc., below Nashville. The total estimated cost of the entire improvement is \$1,964,500.

Under this project appropriations aggregate \$440,000, which, with receipts from sales and repayments, \$974.05, makes a total of \$440,974.05. Of the latter amount about \$26,292.86 is chargeable to maintenance, leaving \$414,681.19 applicable to work of improvement.

The total expenditures under this project to June 30, 1907, amount to \$419,573.27, of which sum about \$18,010.14 has been applied to maintenance.

These expenditures have resulted in the periodical removal of snags and other surface obstructions from the navigable channel, the protection of the bank of a part of Cumberland Island in Kentucky chute at the mouth of the river, and the completion and placing in operation of Lock A, whereby 6-foot navigation has been afforded all year round for a distance of 38.8 miles above the lock. The season of profitable navigation from the Ohio River to Nashville has been prolonged by forty-five to ninety days, depending on the stage of water, making it now average eight months annually.

The Cumberland River below Nashville is usually navigable for all steamboats plying on it for six months in each year; for boats not drawing over 3 feet, from six to eight months, and for boats drawing 16 inches or less, the whole year. General navigation, however, is practically closed for several months each year during low water. As a general rule, when the stage is below  $2\frac{1}{2}$  feet, navigation is closed; between  $2\frac{1}{2}$  feet and 5 feet, it is uncertain, and above 5 feet, good. A table is given on page 390 of the Annual Report of the Chief of Engineers for 1902 showing the stages at Burnside, Carthage, Nashville, and Clarksville for the years 1898-1902.

The reported commerce for the calendar year 1906 was 223,899 tons, having an estimated value of about \$3,678,420; passengers carried, 6,000. The tonnage consisted principally of timber and farm products.

It is reported that the Tennessee Central Railroad, which parallels the Cumberland River from Nashville to Clarksville, had rates in force before the completion of Lock and Dam A of from 18 to 26 cents per 100 pounds, and since this lock was put in operation these rates have been reduced above the lock to from 6 cents to 12 cents per 100 pounds.

The quantity of grain handled by the local steamboats has increased considerably since the completion of Lock A.

The balance available will be applied to expenses of making complete location survey for locks and dams in Cumberland River below Nashville, authorized by the act of March 2, 1907, and to the necessary maintenance.

Additional details and maps relating to this section are given in the report of survey, Annual Report of 1890, page 2152, and the report of the Board of Engineers officers, Annual Report of 1888, page 1626.

For report of the Board of Engineers for Rivers and Harbors under date of February 26, 1906, concerning the further improvement of Cumberland River, see House Document No. 699, Fifty-ninth Congress, first session.

July 1, 1906, balance unexpended-----	\$22, 632. 95
June 30, 1907, amount expended during fiscal year:	
For works of improvement (survey)-----	\$1, 171. 27
For maintenance of improvement-----	60. 90
	<hr/> 1, 232. 17
July 1, 1907, balance unexpended-----	21, 400. 78
July 1, 1907, outstanding liabilities-----	1, 078. 46
	<hr/> July 1, 1907, balance available-----
	20, 322. 32
Amount (estimated) required for completion of existing project--	1, 549, 818. 81

(b) *Above Nashville (357 miles).*—This section extends from Nashville to the mouth of Rockcastle River. In its original condition it was considerably obstructed by rock reefs, ledges, snags, etc., which greatly impeded navigation between Nashville and Burnside (about 325 miles), while above Burnside the Smith shoals formed a serious obstruction to navigation at practically all stages.

The original scheme of improvement above Nashville, as modified and extended, contemplated open-channel work from Nashville, Tenn., to Cumberland Ford (Pineville, Ky.), 497 miles, at an estimated cost of \$374,764, and was based on projects submitted January 20, 1871, and February 8, 1872.

The first appropriation specifically applicable to the Cumberland River above Nashville was made by the act of August 14, 1876.

This open-channel scheme of improvement, or old project, resulted in giving increased depths at several of the principal obstructions, thus securing a longer and safer period of navigation. Under this project and its modifications appropriations aggregating \$346,000 were made and expended.

The project for the canalization of the Cumberland River above Nashville, based on reports of an examination and survey in 1882 and 1883, was adopted August 5, 1886, by river and harbor act of that date.



This scheme of improvement provided for the construction of 22 locks and dams below Burnside, Ky., and 6 locks and dams at Smith shoals, above Burnside, the intention being to provide a complete system of lockage from Nashville, Tenn., to Rockcastle River, so as to afford a channel depth of 6 feet, the locks to be 52 feet wide and 280 feet long, with lifts varying from 10 to 12 feet, at an estimated cost of \$8,500,000.

The river and harbor act of March 3, 1905, authorized continuing contract for the completion of Lock and Dam No. 21, to the amount of \$200,000, in addition to a direct appropriation of \$74,000 and the available funds to the credit of any project above said lock and dam. Under this act all but \$50,000 has been appropriated.

The same act authorized the Cumberland River Improvement Company of Kentucky to improve the Cumberland River and tributaries, including the South Fork, above Burnside, Ky., at its own expense, by construction of necessary locks and dams under Government supervision, and to use the resulting water power with the provisions that such use shall not impede navigation, that the locks and dams shall be at least equal in size and capacity to other locks and dams constructed on the Cumberland River, and that the company may collect toll for their use for forty years after their completion at rates to be fixed by the Secretary of War.

On February 16, 1905, the Board of Engineers for Rivers and Harbors reported on the project of canalization as follows:

The Board is of the opinion that the regulation of the river and \* \* \* the completion of Locks and Dams 3, 4, 5, 6, and 7 above Nashville, so as to carry the improvement of the river from its mouth to Carthage, Tenn., is worthy of being continued by the United States, but that the construction of the locks and dams proposed between Carthage and Burnside, except No. 21, now under contract, is not at present justified by the commerce involved.

The river and harbor act of March 2, 1907, adopted the modified project for completing the improvement in accordance with this report, by providing for the completion of Locks and Dams Nos. 3, 4, 5, 6, and 7 at an additional expenditure of \$550,000, thus reducing the cost of the project as modified to \$2,769,000. The act appropriated \$150,000 and authorized continuing contracts in the further sum of \$400,000, which is yet to be appropriated, for completing the project.

Under the project of canalization, appropriations aggregating \$2,319,000 have been made; \$475.90 has been received from recoveries, sales, etc., making a total of \$2,319,475.90. Of this amount, about \$32,036.95 is chargeable to maintenance, leaving \$2,287,438.95 applicable to works of improvement. The total expenditures under this project to June 30, 1907, amount to \$1,936,120.53, of which sum about \$27,407.46 was applied to maintenance.

These expenditures have resulted in the periodical removal of snags and other obstructions; the completion and operation of Lock and Dam No. 1 (2.5 miles below Nashville); the completion of masonry required for lock walls and abutments of Dams Nos. 2, 3, 4, 5, 6, and 7 (9, 26, 44.7, 72, 89, and 106.6 miles, respectively, above Nashville); the purchase of sites for abutment at No. 8 (125.2 miles above Nashville), and for locks and abutments at Nos. 21 and 22 (296.2 and 320.2 miles, respectively, above Nashville); the letting

and partial execution of contracts for the completion of Locks and Dams Nos. 2 and 21, and the selection of sites for the locks of the Smith shoals system.

The Cumberland River is navigable usually from Nashville to Burnside, Ky., 325 miles, for steamboats drawing not more than 3 feet, from four to six months of each year, and for boats of greater draft from two to three months. The fall is 223 feet, or about 8 inches per mile.

From Nashville to Caney Fork River (Carthage, 116 miles) the river is navigable for steamboats of 2½ feet draft from six to eight months, and for those of greater draft four or five months. Steamboats of light draft can ascend to Burkesville, 236 miles above Nashville, for from five to seven months and larger boats four or five months. The head of navigation is Burnside, Ky.

The completion of Lock and Dam No. 1 gives 6-foot navigation the year round for a distance of 12½ miles above Lock No. 1, or 10 miles above Nashville, and affords a good harbor at Nashville, where a number of new boats and barges were put in commission as a result of the improvement.

It is expected to put Lock No. 2 in operation during the coming autumn. This will form a pool extending to a point 26 miles above Nashville. The contract for Lock and Dam No. 21 provides for completion on or before December 1, 1907, and the contract for gates, etc., provides for erection in place within forty available working days after the completion of the masonry necessary for erection.

Plans were prepared and advertisement made May 15, 1907, soliciting proposals for the construction, delivery, and erection of two steel lock gates, and construction and delivery of the filling valves and maneuvering appliances for each of Locks 3, 4, 5, 6, and 7. Five proposals were received and were opened June 15, 1907. The contract for the gates was awarded to the lowest bidder, the Penn Bridge Company, of Beaver Falls, Pa., in the sum of \$73,500. The award of the contract for the filling valves had not been agreed upon at the close of the fiscal year.

The early completion of the work at Locks 3, 4, 5, 6, and 7, where the more expensive masonry parts have already been built, is regarded of great importance, as this is necessary to make the improvement available and will provide a permanent channel for navigation from Nashville to Carthage and the Caney Fork River. When these locks are in operation the effect of the project on freight rates will be more fully apparent.

It is proposed to apply the amount estimated as a profitable expenditure in fiscal year 1909 as follows: Two hundred thousand dollars to the continuing contract work on Locks and Dams 3 to 7, inclusive, and \$50,000 to the work of placing Lock 21 in operation.

The commerce on the Cumberland River above Nashville for calendar year 1906, as nearly as could be ascertained, aggregated 334,351 tons, having an estimated value of about \$7,571,305; passengers carried, 12,365. The tonnage consisted mainly of timber and farm products and general merchandise.

For references to surveys see page 495, Annual Report of Chief of Engineers, 1906.

July 1, 1906, balance unexpended.....	\$281, 684. 77
Amount appropriated by river and harbor act approved March 2, 1907.....	150, 000. 00
Amount appropriated by sundry civil act approved March 4, 1907.....	30, 000. 00

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461, 684. 77

June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$76, 467. 81
For maintenance of improvement.....	1, 861. 59

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78, 329. 40

July 1, 1907, balance unexpended.....	383, 355. 37
July 1, 1907, outstanding liabilities.....	8, 181. 16

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July 1, 1907, balance available .....	375, 174. 21
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July 1, 1907, amount covered by uncompleted contracts.....	209, 487. 05
Amount (estimated) required for completion of existing project.....	450, 000. 00

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{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907.....	250, 000. 00	
		Submitted in compliance with requirements of sundry civil act of June 4, 1897.

(See Appendix C C 2.)

3. *Operating and care of locks and dams on Cumberland River.*—Lock A, 41.4 miles below Nashville, and Lock No. 1, 2.5 miles below Nashville, were put in operation November 26, 1904. They have an available length of 280 feet, a clear width of 52 feet between walls, and a depth of  $6\frac{1}{2}$  feet on miter sills at low water, except at lower miter sill of Lock A, where the present low-water depth is only 1 foot. This depth will be increased to  $6\frac{1}{2}$  feet by the construction of the next lock below.

The first allotment from the indefinite appropriation of July 5, 1884, for the operation and care of these locks was made June 26, 1905.

During calendar year 1906 traffic past Lock A was about 63,445 tons and past Lock No. 1 about 56,551 tons.

The amount expended to June 30, 1907, was \$12,551.88, of which \$6,950.58 was expended during the past fiscal year.

(See Appendix C C 3.)

4. *Caney Fork River, Tennessee.*—This stream lies in the central part of Tennessee. After a course of about 200 miles, wholly in the State, it empties into the Cumberland River at Carthage, Tenn., about 116 miles above Nashville. It is the largest tributary of the Cumberland River.

In its original condition the principal difficulties were found to be rock reefs, gravel and sand bars, and a crooked and shallow channel greatly impeded by surface obstructions.

No work was done by the United States prior to that begun under the present project. The present project, adopted June 14, 1880, is based on the report of 1879, and an extension of the project is based on the report of 1886. It provides for improving the 92 miles of river from Franks Ferry, the head of navigation, to its mouth, Carthage, Tenn., by removing the surface obstructions, building rip-rap dams and training walls, so as to obtain sufficient water for safe navigation during boating season for steamboats drawing not more than 3 feet, at an estimated cost of \$45,228. (Annual Report Chief of Engineers, 1887, p. 1767.)

Under this project appropriations aggregating \$28,000 have been made and \$25,113.30 expended to close of the fiscal year ending June 30, 1907.

From August, 1880, when the first work was done, to August, 1891, when the last work was done, \$25,000 was expended. The results were an improvement of the channel at a 3-foot stage from Franks Ferry to the mouth of the river. The improvement, however, was not permanent and can not be made so under the present project. The additional work required is therefore practically for maintenance.

In view of the meager benefits resulting, it is not believed that future appropriations are warranted under this project.

The effect of the improvement on freight rates is not believed to be important and can not be readily ascertained.

The commerce on the Caney Fork River for calendar year 1906, as nearly as could be ascertained, aggregated 815 tons, having an estimated value of \$8,550.

Amount appropriated by river and harbor act approved March 2, 1907.	\$3,000. 00
June 30, 1907, amount expended during fiscal year, for maintenance of improvement	113. 30

July 1, 1907, balance unexpended	2,886. 70
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(See Appendix C C 4.)

5. *Removing sunken vessels or craft obstructing or endangering navigation.*—An allotment of \$800 was made for removing wreck of steamer *Bart E. Linehan*, which was sunk in the Cumberland River at Nashville, Tenn. Owing to unusual high water prevailing, its removal could not be completed during the past fiscal year. It is expected that the removal will be made during the coming low-water season. No expenditures were made.

An allotment of \$800 was made for removal of wrecked wharf boat at Nashville, Tenn. (hull of the old steamer *Mayflower*), lying in the Cumberland River, and an emergency contract was entered into October 23, 1906, for its removal. Owing to continued high water only about one-half was removed during the fiscal year, and the contractor was granted additional time for its complete removal. It is expected to finish the work of removal during the coming low-water season.

The expenditures during the year amounted to 90 cents.

(See Appendix C C 5.)

#### IMPROVEMENT OF TENNESSEE RIVER AND ITS TRIBUTARIES.

This district was in the charge of Maj. H. C. Newcomer, Corps of Engineers, until February 25, 1907, with First Lieut. W. G. Caples, Corps of Engineers, under his immediate orders; in the temporary charge of Lieutenant Caples from February 25 to June 18, 1907, and in charge of Maj. Wm. W. Harts, Corps of Engineers, since that date, with Lieutenant Caples under his orders. Division engineer, Lieut. Col. Clinton B. Sears, Corps of Engineers, until July 16, 1906, and Col. E. H. Ruffner, Corps of Engineers, since that date.

## TENNESSEE RIVER SYSTEM.

The Tennessee River is 652 miles long. It is formed by the junction of the French Broad and Holston rivers, 4.5 miles above Knoxville and 188 miles above Chattanooga, and flows into the Ohio at Paducah, 464 miles below Chattanooga. Together with its principal tributaries it forms a system of internal waterways capable of being navigated more than 1,300 miles by steamboats. In addition to this, its tributaries are still further navigable by rafts and flatboats for a distance of more than 1,000 miles, thus making a system of navigable waters about 2,350 miles in length, with a drainage area of about 44,000 square miles.

The river is navigable the entire year from the mouth to Riverton, Ala. Just above Riverton a lateral canal about 8 miles long is now under construction past the Colbert and Bee Tree shoals, and the Muscle Shoals Canal now surmounts the Big Muscle and Elk River shoals.

Under the act of April 26, 1904, as amended by act of January 7, 1905, a lock and dam to be built mainly by private parties are projected at Hales bar, designed to form a pool extending 33 miles upstream to Chattanooga.

Local boat lines have headquarters at the principal towns along the river. There is no through traffic covering the entire length of the river, the longest regular boat service being found between Chattanooga and Paducah when the stage of water permits.

From commercial statistics given later in detail it will be seen that the total commerce on the Tennessee River during the calendar year 1906 amounted to about 1,655,384 tons, valued at about \$24,520,000. From this total, however, about 76,624 tons should be deducted on account of having been duplicated in reports for different sections of the river.

The amount so far appropriated and allotted for the Tennessee River and the canals thereon is \$8,121,248.83. Of this sum \$1,010,873.98 has been allotted for operating and care and repair of the Muscle Shoals Canal from November, 1890, when it was opened to navigation, to June 30, 1907.

Freight rates are said to be already considerably lowered by this project, but there is no information available indicating to what extent they will be affected by its completion.

1. *Tennessee River.*—The improvement has been carried on in three sections under separate appropriations.

(a) *Above Chattanooga, Tenn. (188 miles).*—In its original condition this part of the river was obstructed by rock reefs, bowlders, gravel bars, and snags. The depth of water on the bars varied from 10 to 30 inches at low water, and in some places the current was as great as 6 miles an hour. The average slope is 0.956 foot per mile, with average low-water discharge varying from about 3,000 cubic feet per second at Knoxville to about 6,000 cubic feet per second at Chattanooga.

The present project, adopted by Congress in act of August 18, 1894, is to obtain by training walls, wing dams, and dredging a low-water channel 3 feet deep from Chattanooga to the mouth of the French Broad River, at an estimated cost of \$650,000. Up to June 30, 1895, the sum of \$328,255.83 had been expended under a previous project,

and there remained 55 obstructions having less than 3 feet depth at low water. A revision of the estimate in 1907, on a basis of present unit prices, places the cost of the existing project at \$1,709,000. The total amount expended under the present project up to June 30, 1907, was \$199,124.16, including \$11,661.08 for maintenance.

It is proposed to apply the appropriation of March 2, 1907, \$104,000, to the construction of such floating plant as may be found necessary to prosecute the work economically; to the systematic improvement of the shoals from Caney Creek, about 98 miles above Chattanooga, down to Shields dam, a stretch of about 4 miles, and of such other shoals as principally interfere with general navigation.

The maximum draft that can be carried at mean low water over the shoalest place in this section is about 18 inches. The extreme flood oscillations range from about 40.5 feet at Knoxville to about 58 feet at Chattanooga.

The commerce on this portion of the river during the calendar year 1906 amounted to about 475,515 tons, valued at about \$3,443,923; the principal items, in order of value, being general merchandise, forest products, farm products, and iron ore.

A map of this section of the river is found in the Annual Report of the Chief of Engineers for 1876, page 710, and an account of its survey in the report of 1893, page 2333.

The river and harbor act of March 2, 1907, authorized the expenditure, in the discretion of the Secretary of War, from the appropriation therein made, of \$1,000 for improvement of Little Tennessee River; and accordingly this amount was so allotted, to be used in clearing obstructions from the channel. For details of the Little Tennessee River see the report of survey in Annual Report of the Chief of Engineers for 1901, page 2496. The total expenditure on improvement of the Little Tennessee to June 30, 1907, amounted to \$5,388.32.

## TENNESSEE RIVER ABOVE CHATTANOOGA.

July 1, 1906, balance unexpended	\$20,366.60
Amount appropriated by river and harbor act approved March 2, 1907	105,000.00
	<hr/> 125,366.60
Allotment for improving Little Tennessee River	\$1,000.00
June 30, 1907, amount expended during fiscal year:	
For works of improvement	18,074.99
For maintenance of improvement	4,518.75
	<hr/> 23,593.74
July 1, 1907, balance unexpended	101,772.86
July 1, 1907, outstanding liabilities	4,630.66
	<hr/>
July 1, 1907, balance available	97,142.20
Amount (estimated) required for completion of existing project	1,080,000.00

## LITTLE TENNESSEE RIVER.

July 1, 1906, balance unexpended	\$974.31
Amount allotted from appropriation by river and harbor act approved March 2, 1907	1,000.00
	<hr/> 1,974.31
June 30, 1907, amount expended during fiscal year, for maintenance of improvement	362.63
	<hr/>
July 1, 1907, balance unexpended	1,611.68

(b) *Chattanooga, Tenn., to Riverton, Ala. (238 miles).*—In its original condition the channel from Chattanooga to Browns Ferry was obstructed by bars, bowlders, reefs, and rocky projections. Navigation was possible during six to nine months annually. Between Browns Ferry and Florence were the Muscle shoals obstructions, which could be crossed only at unusually high water. Between Florence and Riverton the Colbert and Bee Tree shoals prevented navigation for six months in the year.

The average slope is 1.5 feet per mile from Chattanooga to Scott Point (17.5 miles), thence 0.4 foot per mile to head of Muscle Shoals Canal (158 miles), thence 2.73 feet per mile to Riverton (62.5 miles), with average low-water discharge varying from about 6,000 cubic feet per second at Chattanooga to about 10,000 cubic feet per second at Riverton.

Under a former project the Muscle shoals section was improved at a cost of \$3,191,726.50 by some channel work at Little Muscle shoals and by the construction of a lateral canal in two divisions, one on the left bank about 3.5 miles long, with 2 locks, around the Elk River shoals, and the other on the right bank, about 14.5 miles long, with 9 locks, around the Big Muscle shoals. This work was done mainly from 1875 to 1890, under a project adopted originally in 1868.

The present project also dates back in part to 1868, but it has been modified in several particulars since then, so that at present it provides for a lock and dam to be built mainly by private parties (under the authority of Congress) at Hales bar, about 33 miles below Chattanooga, forming a pool that will extend to Chattanooga with a depth of at least 6 feet at low water; for open-channel work to secure a depth of 5 feet at low water from Hales bar to Lock A (about 14½ miles); and for the improvement of the Colbert and Bee Tree shoals (between Florence and Riverton) by the construction of a lateral canal about 8 miles long, with 1 lock.

There has also been considerable open-channel work under former modifications of the project between Chattanooga and Hales bar and at Colbert and Bee Tree shoals. A revision in 1907 of the estimate for open-channel work on a basis of present unit prices places the cost of additional work required at \$1,031,000.

Work under continuing contracts amounting to about \$350,000 is now in progress at the Colbert Shoals Canal, as authorized by the river and harbor acts of June 13, 1902, March 3, 1905, and March 2, 1907. The latter act also appropriated \$62,970 for the completion of the Hales bar lock and dam, and authorized the continuous-contract system as applied to Colbert Shoals Canal to be extended to the amount of \$213,000, which is yet to be appropriated.

The total amount expended under the present project to June 30, 1907, was \$2,015,955.24. This expenditure has resulted in the partial preparation of plans for Hales bar lock and dam and the supervision of this work, at a cost of \$8,926.41; in the partial improvement of the open-river channel, extending the period of navigation at low water, at a cost of \$595,532.74, and in the partial construction of the Colbert Shoals Canal, including the completion of about 95 per cent of the masonry of the lock, the purchase of land for the canal, the construction of 4,578 cubic yards, or about 14 per cent of the concrete river

wall, and the excavation of 148,435 cubic yards of rock and 1,305,864 cubic yards of earth and hardpan from the canal trunk, or about 65 per cent of the total excavation, at a cost of \$1,411,496.09, including outstanding liabilities.

The Muscle Shoals Canal provides a permanent depth of 5 feet, except in its approaches, where additional work will be required to secure this depth at low water. The maximum draft that can be carried at mean low water over the shoalest place between Chattanooga and Riverton is about 2 feet. The extreme flood oscillations range from about 69 feet at the Suck, 12 miles below Chattanooga, to about 10 feet at Lock 4 of the Muscle Shoals Canal.

It is proposed to apply the appropriations made for this work by the river and harbor act of March 2, 1907, as follows:

The \$62,970 for Hales bar, to the completion of the lock gates and other metal parts and to the superintendence of the work; the \$200,000 for Colbert Shoals Canal, together with the \$100,000 appropriated by the sundry civil act of March 4, 1907, toward the completion of that work, and the \$205,000 for the section between Chattanooga and Riverton to the improvement of the channel by regulation works and dredging, including the construction of such floating plant and maintenance of existing works as may be found necessary.

The unit prices at which existing contracts have been let indicate that the Colbert Shoals Canal can be completed well within the adopted estimate.

The improvements at Hales bar and Colbert shoals will not be available for navigation until the works are completed.

The commerce carried on the river between Chattanooga and Florence during the calendar year 1906 amounted to about 413,751 tons, valued at about \$10,146,386; the principal items in order of value being general merchandise, farm products, and forest products.

For references to details of the river from Chattanooga to Riverton, see Annual Report of the Chief of Engineers for 1905, page 456.

The appropriation asked for will be applied to completion of the lock walls and gates of the Colbert and Bee Tree Shoals Canal and toward the completion of the canal trunk and the revetment of its banks.

## OPEN-CHANNEL WORK.

July 1, 1906, balance unexpended.....	\$11, 164, 80
Amount appropriated by river and harbor act approved March 2, 1907.....	205, 000. 00
	<hr/> 216, 164. 80
June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$9, 198. 38
For maintenance of improvement.....	292, 18
	<hr/> 9, 490. 56
July 1, 1907, balance unexpended.....	206, 674. 24
July 1, 1907, outstanding liabilities.....	7, 359. 60
	<hr/> 199, 314. 64
Amount (estimated) required for completion of existing project..	1, 031, 000. 00



## HALES BAR LOCK AND DAM.

July 1, 1906, balance unexpended	\$46,519.56
Amount appropriated by river and harbor act approved March 2, 1907	62,970.00
Proceeds sale of maps	18.29
	<hr/> 109,507.85
June 30, 1907, amount expended during fiscal year, for maintenance of improvement	5,445.97
July 1, 1907, balance unexpended	104,061.88
July 1, 1907, outstanding liabilities	255.75
July 1, 1907, balance available	<hr/> 103,806.13
July 1, 1907, amount covered by uncompleted contracts	<hr/> 24,758.00

## COLBERT AND BEE TREE SHOALS.

July 1, 1906, balance unexpended	\$541,050.03
Amount appropriated by river and harbor act approved March 2, 1907	200,000.00
Amount appropriated by sundry civil act approved March 4, 1907	100,000.00
	<hr/> 841,050.03
June 30, 1907, amount expended during fiscal year, for works of improvement	257,529.42
July 1, 1907, balance unexpended	583,520.61
July 1, 1907, outstanding liabilities	59,470.57
July 1, 1907, balance available	<hr/> 524,050.04
July 1, 1907, amount covered by uncompleted contracts	369,574.55
Amount (estimated) required for completion of existing project	<hr/> 852,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907	
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897.	
	213,000.00

(c) *Below Riverton, Ala. (226 miles).*—This part of the river is below most of the large tributaries. It has therefore more water than the upper river, and as the width is not too great and the slope uniform and moderate it is accessible to larger boats. The ruling depths were originally about 3.5 feet over the lower 196 miles and 2 feet above this. The average slope of this section of the river is 0.34 foot per mile, with low-water discharge of about 10,000 cubic feet per second. In 1896 there were 49 shoals having less than 5 feet depth at low water, and two other shoals have since developed.

The existing project is to obtain by dredging a channel not less than 5 feet deep and 150 feet wide, and to protect Livingston Point and Tennessee Island from erosion, with a view to preserving the port of Paducah, Ky.

The total amount expended to June 30, 1907, was \$331,914.78. This expenditure has resulted in the completion of the work at Livingston Point and Tennessee Island, at a cost of \$77,367.65; in the removal of snags, and in about 950,460 cubic yards of dredging at 31 localities, thus removing the worst obstructions below Hamburg. The results of dredging appear to be fairly permanent at about two-thirds of the places improved.

It is proposed to apply the available balance to the improvement and maintenance of the channel at the shoals offering the greatest obstruction to navigation.

The maximum draft that can be carried over the shoalest place in this section at mean low water is about 3 feet. The extreme flood oscillations range from about 48 feet at Johnsonville to about 55 feet at Paducah, Ky.

The commerce carried on the river between Florence and Paducah during the calendar year 1905 amounted to about 766,118 tons, valued at about \$10,930,300, the principal items, in order of value, being general merchandise, forest products, and farm products.

For details of the river from Riverton to Paducah, see Annual Report of the Chief of Engineers for 1897, page 2262.

July 1, 1906, balance unexpended.....	\$18,510.33
Amount appropriated by river and harbor act approved March 2, 1907.....	40,000.00
	<hr/>
	58,510.33
June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$552.81
For maintenance of improvement.....	17,598.77
	<hr/>
	18,151.58
July 1, 1907, balance unexpended.....	40,358.75
July 1, 1907, outstanding liabilities.....	1,421.21
	<hr/>
July 1, 1907, balance available.....	38,937.54

(See Appendix D D 1.)

2. *Operating and care of Muscle Shoals Canal, Tennessee River.*—For details of this canal and of its operation and care, also dimensions of locks, aqueduct, and drift sluice, see pages 2440-2446, Annual Report of the Chief of Engineers for 1901, with corrections given on page 1729 of report for 1902.

The canal was opened to navigation in 1890. It is in two sections, aggregating about 18 miles in length, and has 11 locks. A railroad nearly 15 miles in length is operated in connection with the maintenance of the canal.

Fifteen streams empty into the canal, none of them very large. Bars are constantly forming opposite their mouths and also at the entrances to the canal. A bucket dredge is kept on the canal in order to remove these bars as fast as they form.

The number of commercial steamboats and barges that used the canal during the calendar year 1906 was 835, counting every trip, and the freight carried amounted to about 26,878 tons, the estimated value of which was \$1,074,945. The number of lockages, exclusive of those of Government craft, was 2,483.

The amount expended during the fiscal year ending June 30, 1907, was \$52,763.28.

(See Appendix D D 2.)

3. *French Broad and Little Pigeon rivers, Tennessee.*—The French Broad River is one of the largest tributaries of the Tennessee. It rises in North Carolina, flows in a generally northwesterly direction,

and finally unites with the Holston River in the State of Tennessee, about 4.5 miles above Knoxville, to form the Tennessee River. It has a drainage area of about 5,600 square miles. Leadvale, Tenn., about 70 miles above the mouth, has generally been considered the head of navigation in Tennessee. An isolated portion of the river in North Carolina, between Brevard and Asheville, was under improvement for several years from 1877 to 1882.

In its original condition the river was obstructed by rock reefs, sand and gravel bars, and by bowlders, snags, and overhanging trees, and numerous islands in the river divided the water and diminished the depth in the navigable channels. There were 41 shoals obstructing navigation below Leadvale. The average slope below Leadvale is about 2.3 feet per mile, and the low-water discharge at Leadvale is reported as about 2,000 cubic feet per second.

The Little Pigeon River is formed by the junction of its east and south forks at Sevierville, Tenn., and flows in a northerly direction for about 5 miles, emptying into the French Broad about 29 miles above its mouth. The Little Pigeon is navigable at ordinary stages only about 2 miles above its mouth (to Catlettsburg), and thus practically amounts to an additional landing on the French Broad. In its original condition this portion of the river was obstructed by a bar at its mouth.

The project provides for open-river work on the French Broad to secure a navigable channel at low water from the mouth to Leadvale sufficient to permit the passage of boats drawing about 2.5 feet, at an estimated cost of \$150,000, and for the removal of the bar at the mouth of the Little Pigeon.

The amount expended to June 30, 1907, was \$95,474.17, of which \$4,921.42 was for maintenance. This expenditure has been applied to the improvement of navigation over 15 of the shoal places in the French Broad, the maintenance of the navigable channel, and the removal of the bar at the mouth of the Little Pigeon.

It is proposed to apply the available balance to the improvement and maintenance of the channel.

The maximum draft that can be carried over the shoalest place at mean low water is probably about 18 inches. The extreme flood oscillation is about 30 feet, ordinary floods having a range of about 10 to 15 feet. Steamboats rarely go above Dandridge, 46.5 miles above the mouth, and all the improvements are below this place.

The commerce carried on this river during the calendar year 1906 amounted to about 139,157 tons, valued at about \$976,424; the principal items, in order of value, being farm products, marble, and general merchandise.

For details of the French Broad, see the report of survey in the Annual Report of the Chief of Engineers for 1900, page 3018. An examination of the Little Pigeon is reported in the Annual Report for 1891, page 2287.

The direction of traffic on these streams is not parallel to rail lines. The effect of the improvement on railroad rates, therefore, would be indeterminate, but would doubtless be important.

July 1, 1906, balance unexpended-----	\$2,043. 43
Amount appropriated by river and harbor act approved March 2, 1907-----	2,000. 00
Proceeds transfer of quarter boat-----	500. 00
	<hr/>
	4,543. 43
June 30, 1907, amount expended during fiscal year, for maintenance of improvement-----	515. 64
	<hr/>
July 1, 1907, balance unexpended-----	4,027. 79
July 1, 1907, outstanding liabilities-----	126. 19
	<hr/>
July 1, 1907, balance available-----	3,901. 60
	<hr/>
Amount (estimated) required for completion of existing project----	61,515. 64
(See Appendix D D 3.)	

4. *Clinch, Hiwassee, and Holston rivers, Tennessee.*—(a) *Clinch River.*—This river rises in the Cumberland Mountains in Virginia, and, after following a southwesterly course, empties into the Tennessee River at Kingston, 104 miles above Chattanooga. It drains an area of about 5,000 square miles. Its average slope below Clinton (60 miles from the mouth) is about 1.3 feet per mile. The ordinary low-water discharge at Clinton is about 900 cubic feet per second. There are about 193 miles of the river in the State of Tennessee.

In its original condition the channel was obstructed by rock reefs, sand and gravel bars, bowlders, snags, and overhanging trees.

The present project provides for channel excavations, removing surface obstructions, and the construction of wing dams and training walls, so as to secure a navigable channel 2 feet in depth at ordinary low water from the mouth of the river to Clinton, about 60 miles, and of 1.5 feet in depth from Clinton to Haynes (or Walkers) Ferry, about 66 miles. From Haynes Ferry to the State line, a distance of about 67 miles, it is proposed simply to remove the loose rock and bowlders, reduce the rock ledges, and remove snags, overhanging trees, and similar obstructions, so as to assist raft and flatboat navigation at the stages at which the river is ordinarily used.

The amount expended to June 30, 1907, was \$53,326.53, which had resulted in reducing many of the reefs, removing obstructions from the channel, and building several wing dams and training walls, whereby the channel was so far improved that the river could be used at stages 2 to 3 feet lower than before the improvement was begun.

It is proposed to apply the available balance to the maintenance of the channel.

Small steamboats navigate the Clinch River as far as Clinton.

The total commerce on the Clinch River for the calendar year 1906 was about 112,284 tons (value estimated at \$2,161,130). Logs rafted down the river comprised about 60 per cent of this tonnage, and practically all of the remainder was transported only between Kingston and the mouth, a distance of less than 1 mile. The principal items, in order of value, were general merchandise, forest products, and farm products.

For survey of this river see Annual Report of the Chief of Engineers for 1901, page 2542.

There is no information available indicating the extent to which freight rates will be affected by this improvement.

July 1, 1906, balance unexpended-----	\$1,480.48
Amount allotted from appropriation by river and harbor act approved March 2, 1907-----	325.43
	1,805.91
June 30, 1907, amount expended during fiscal year, for maintenance of improvement-----	305.91
July 1, 1907, balance unexpended-----	1,500.00
July 1, 1907, outstanding liabilities-----	28.84
July 1, 1907, balance available-----	1,471.16

(b) *Hiwassee River*.—The Hiwassee River rises in the mountains of western North Carolina and northern Georgia, flows in a north-westerly direction, and enters the Tennessee River about 35 miles above Chattanooga. Its largest tributary is the Ocoee River, which enters it from the south about 35 miles from its mouth. The Hiwassee drains an area of about 2,725 square miles. Its average slope below the Ocoee is about 0.93 foot per mile. The low-water discharge at the mouth of the Ocoee is given as about 950 cubic feet per second.

On examination, made in 1874, the channel was found to be obstructed by rock reefs, gravel bars, snags, and overhanging trees.

The original project of improvement, based on the examination of 1874, was for a navigable channel 40 feet wide and 2 feet deep at ordinary low water to Savannah Ford, about 41.6 miles from the mouth of the river, to be secured by excavation of rock reefs and gravel bars and construction of wing dams. Expenditures under this project amounted to \$36,427.07.

The present project, based on a survey made in 1899, contemplates the development of a channel of not less than 116 feet width and 30 inches mean depth between the mouth of the river and the mouth of the Ocoee River by use of spur dikes, training walls and submerged sills, bank protection, and dredging, at an estimated cost of \$71,125. There were sixteen shoals having less than the desired depth at low water.

This project was adopted by the river and harbor act of June 13, 1902.

The amount expended thereon to June 30, 1907, was \$20,060.32. This expenditure was applied to maintenance of the navigable channel and to work of improvement at Mathews and Blackbird shoals, about 9 and 17 miles, respectively, above the mouth.

It is proposed to apply the available balance toward the completion of the existing project, undertaking first the improvement of the shoal places between Charleston and the mouth, and to the maintenance of the channel.

The maximum draft that can be carried over the shoalest place at mean low water is about 2 feet. The extreme flood oscillation at Charleston, 19 miles above the mouth, is about 32 feet, but ordinary floods do not exceed about 15 to 18 feet. Small boats of about 100 tons capacity can navigate the river eight months in the year. Savannah Ford, 7 miles above the mouth of the Ocoee River, has at times been reached by steamboats, and is usually regarded as the head of steamboat navigation.

The commerce on the Hiwassee River during the calendar year 1906 amounted to 3,563 tons, valued at \$139,225; the principal items being general merchandise, farm products, and forest products.

For report of survey see Annual Report of the Chief of Engineers for 1901, page 2458.

There is no information available indicating the extent to which freight rates will be affected by the improvement. It will probably be slight.

July 1, 1906, balance unexpended.....	\$4,460.80
Amount allotted from appropriation by river and harbor act approved	
March 2, 1907.....	55,282.40
	<hr/> 59,743.20

June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$7,952.00
For maintenance of improvement.....	1,987.96
	<hr/> 9,939.96

July 1, 1907, balance unexpended.....	49,803.24
July 1, 1907, outstanding liabilities.....	1,153.77
	<hr/>

July 1, 1907, balance available.....	48,649.47
--------------------------------------	-----------

(c) *Holston River*.—The Holston River is formed by the junction of its north and south forks at Kingsport, Tenn., and flows thence about 142 miles in a southwesterly direction and unites with the French Broad 4.5 miles above Knoxville to form the Tennessee River. It drains an area of about 3,811 square miles. It has an average slope of about 2.5 feet per mile and a minimum discharge of about 650 cubic feet per second.

In its original condition the channel was obstructed by rock reefs and ledges, bowlders, snags, and overhanging trees. The present project, adopted in 1902, provides for the removal of channel obstructions and cutting overhanging trees from the mouth to Kingsport, at an estimated cost of \$5,000.

The amount expended to June 30, 1907, was \$4,517.17, which resulted in clearing the channel of some of the worst obstructions between the mouth and Riddleys shoals, a distance of about 137 miles.

It is proposed to apply the available balance to the maintenance of the channel.

There is no regular upsteam navigation of the river. Occasionally a small steamboat runs up 30 to 60 miles from the mouth during periods of high water.

The commerce reported for the calendar year 1906 consisted of about 19,800 tons of logs rafted, the value of which was estimated at about \$168,300.

For report of survey, see Annual Report of the Chief of Engineers for 1901, page 2518.

There is no information available indicating the extent to which freight rates will be affected by this improvement. It will probably be slight.

July 1, 1906, balance unexpended.....	\$1,386.34
Amount allotted from appropriation by river and harbor act approved	
March 2, 1907.....	1,017.17
	<hr/> 2,403.51
June 30, 1907, amount expended during fiscal year, for maintenance	
of improvement.....	903.51
	<hr/>
July 1, 1907, balance unexpended.....	1,500.00

## CONSOLIDATED.

July 1, 1906, balance unexpended-----	\$7, 327. 62
Amount appropriated by river and harbor act approved March 2, 1907-----	56, 625. 00
	<hr/> 63, 952. 62
June 30, 1907, amount expended during fiscal year:	
For works of improvement-----	\$7, 952. 00
For maintenance of improvement-----	3, 197. 38
	<hr/> 11, 149. 38
July 1, 1907, balance unexpended-----	52, 803. 24
July 1, 1907, outstanding liabilities-----	1, 182. 61
	<hr/> 51, 620. 63

(See Appendix D D 4.)

5. *Removing sunken vessels or craft obstructing or endangering navigation.*—Under an allotment from the indefinite appropriation made by section 20 of the river and harbor act approved March 3, 1899, a sunken barge (unnamed) which obstructed the navigable channel of the Tennessee River at Florence, Ala., was entirely removed, at a cost of \$109.15.

(See Appendix D D 5.)

IMPROVEMENT OF OHIO RIVER BY OPEN-CHANNEL WORK AND BY CONSTRUCTION OF LOCK AND DAM NO. 37; OPERATING SNAG BOATS ON OHIO RIVER BELOW THE PENNSYLVANIA STATE LINE.

This district was in the temporary charge of Maj. J. G. Warren, Corps of Engineers, to August 15, 1906, and in the charge of Lieut. Col. Wm. T. Rossell, Corps of Engineers, since that date. Division engineer, Col. G. J. Lydecker, Corps of Engineers.

1. *Ohio River (general open-channel improvement).*—This work was commenced by the General Government in 1827, when low-water navigation over many of the bars and shoals was impossible for commercial purposes; but the improvements made and maintained since then have provided fairly convenient channels at such places for a profitable light-draft local freight and passenger service during low-water periods. The difference in level of water surface of the river varies; at Cincinnati, nearly midway between the head and mouth of the river, the average annual range during the past thirty years is 47.6 feet.

The project under which operations have been carried on has been a continuous and progressive one, the principal features of the work being the removal of snags, rocks, and wrecks from the general channel; the direct improvement of bars and shoals, by dredging and rock excavation; the construction, repair, and maintenance of low dikes and dams to concentrate and direct the flow of water in improved channels; bank protection and the construction and repair of levees where required in the interest of navigation; the construction, repair, and maintenance of ice piers and harbors; miscellaneous improvement, including surveys, establishment, care, and record of water gauges, establishment of harbor lines, regulation of encroachment and deposits on the banks of the river or in its channel, and the supervision of construction of bridges across the river. The length of river through which the work extends is but little short of 1,000 miles, and

the total expenditure in this district by the Government during the eighty years it has been in progress, exclusive of liabilities outstanding June 30, 1907, is \$6,755,400.29.

The river and harbor act of March 2, 1907, appropriated \$20,000 for repairing Great Miami embankment of Ohio River east of Lawrenceburg, Ind., if such repair should be directly and necessarily required in the interest of navigation.

The principal operations of the last fiscal year were as follows:

The U. S. dredges *Ohio* and *Oswego* excavated 77,496 cubic yards of gravel, sand, etc., and 8.6 tons of rock and sunken logs, and the hired dredging plant excavated 6,105 cubic yards of sand, gravel, and loose rock. The work of the dredges has resulted in improvement of the channel, making a depth of 4 to 6 feet below low water at Fulton bar, Chenaults reach, Big Blue River bar, Short Creek bar, Wells bar, Bakers Island, Captina Island, and Fish Creek Island.

Plans and specifications were prepared for low dams at the head of Browns and Marietta islands, and proposals were advertised for. Bids for Browns Island work will be opened July 18, 1907. The proposals for work at Marietta Island should have been opened June 29, but no bids were received, and a readvertisement will be necessary. In response to advertisement for proposals to construct a low dike at Grand Chain, a single bid was received June 6. The prices asked for in this bid were so high, compared with all past experience, that it was deemed best to readvertise the work. The work on dikes at Mound City, Ill., is now under contract, but, owing to the high stages of river which prevailed, no work was done during the fiscal year. Under contract dated June 30, 1905, work on the ice pier at Gallipolis, Ohio, was in progress as follows: Timber protection, 3,982 feet B. M.; pumping, seven days; excavation, 518.84 cubic yards; wrought iron or steel, 211 pounds, and concrete masonry laid, 190.8 cubic yards. The footing of foundation is now in place. Supervision was had of established harbor lines at Steubenville, Ohio, Wheeling, W. Va., Ironton, Ohio, and Cincinnati, Ohio. Work in connection with tentative harbor lines at East Liverpool, Ohio, was in progress, and maps of same are now in course of preparation. Twenty-six permits were issued by the War Department to cover construction of gas and water pipe lines, overhead and submarine cables, inclines, tracks, waterworks intakes, coal elevator, dredging, bank protection, etc. Plans for work on bridges at Steubenville, Ohio, Bellaire, Ohio, channel back of Wheeling Island, and Parkersburg, W. Va., were approved by the Secretary of War. Supervision was had of permits for all miscellaneous and bridge constructions.

The nature of the Ohio River is such that its improvement, whether by canalization (locks and dams) or open channel, can not bring full benefit to navigation interests until the improvement shall have become more continuous than past appropriations have permitted. The unimproved portions afford less depth of channel than the improved sections and limit the available draft for the whole river to that required for passing its shoalest parts. Dredging and snagging operations will be required at many places, even should a more or less complete system of canalization be finally adopted, and for open-channel improvement continuous work and simultaneous operations will be absolutely necessary to produce effective results. The Government plant should be largely increased in order that any great



amount of work may be accomplished during the comparatively short periods to which effective operations must be limited each year on account of unfavorable river conditions. Several light-draft towboats, barges, and derrick boats for dike construction and removing rocks or other obstructions are all urgently needed before anything approximating satisfactory progress can be expected.

The available depth in the Ohio River varies greatly with the fluctuation in river stages. During the fiscal year the available depth has been above the average. This was due, however, to heavy rainfall rather than to permanent improvement of channel.

The fluctuations in river stages are indicated by the following readings from characteristic river gauges:

	Highest.	Date.	Lowest.	Date.	Range.
	<i>Fect.</i>	1907.	<i>Fect.</i>	1906.	<i>Fect.</i>
Pittsburg, Pa., or Davis Island dam <sup>a</sup> .....	35.8	Mar. 15	2.2	July 16	33.6
Wheeling, W. Va.....	48.9	Mar. 16	2.4	July 13	46.5
Parkersburg, W. Va.....	51.4	do	2.7	July 16	48.7
Point Pleasant, W. Va.....	54.8	Mar. 18	1.7	July 17	53.1
Portsmouth, Ohio.....	60.8	do	5.2	do	55.6
Cincinnati, Ohio.....	65.1	Jan. 21	7.1	Sept. 22	58.0
Louisville, Ky. (head).....	41.2	Jan. 22	3.1	Sept. 20	38.1
Evansville, Ind.....	46.2	Jan. 24	5.1	Sept. 21	41.1
Paducah, Ky.....	45.8	Jan. 28	6.3	July 12	39.5
Cairo, Ill.....	50.3	Jan. 27	13.6	Sept. 23	36.7

<sup>a</sup> Pittsburg gauge used when dam was down and Davis Island when dam was up.

The available depth in channel may be considered 1 foot greater than gauge readings from Pittsburg to Louisville and 2 feet greater from Louisville to Cairo.

During the fiscal year no work was done to increase the available depth, but work was confined to the removal of snags and other obstructions and increasing the width of narrow low-water channels, thus bettering navigable conditions.

No estimate can be given of the effect of the improvement thus far made on freight rates. The comparative rates between Pittsburg, Pa., and Memphis, Tenn., by rail and by river, were estimated in 1903 as follows:

	Pittsburg-Memphis.	
	Miles.	Per ton.
Soft coal:		
By railroad.....	807	\$3.73
By steamboat.....	1,218	.42

In order to provide for navigation during comparatively low-water periods in winter, many of the existing dikes and dams will require to be kept in a state of repair, as the movable dams can not safely be operated during a time of even light running ice, although properly protected steamboats may be able to navigate at such time. The severe losses to floating craft during recent years have shown the importance of maintaining certain of the harbors of refuge afforded by existing ice piers and the providing of others at carefully selected localities. Special surveys, designed to fill in and complete the skeleton work now outlined in connection with the investigations of the

Board of Engineer officers appointed to examine and report upon the Ohio River, will be required at many points.

The commerce of the river during the past year, so far as indicated by statistics that the engineer officer in charge of the river has been able to obtain, was as follows: General merchandise, coal, etc., 11,427,784 tons, at an estimated value of \$79,994,488; passengers, 4,349,069.

July 1, 1906, balance unexpended-----	\$278,673.43
Amount appropriated by river and harbor act approved March 2, 1907-----	470,000.00
July 3, 1906, to May 28, 1907, amount received from sale of blue-prints and charts-----	49.31
December 29, 1906, and June 12, 1907, amount received from sale of condemned and unserviceable property-----	387.46
	<hr/> 749,110.20

June 30, 1907, amount expended during fiscal year:	
For works of improvement-----	\$47,711.62
For maintenance of improvement, \$11,356.01, less \$1.10 refunded-----	11,354.91
	<hr/> 59,066.53

July 1, 1907, balance unexpended-----	690,043.67
July 1, 1907, outstanding liabilities-----	4,563.98

July 1, 1907, balance available-----	<hr/> 685,479.69
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July 1, 1907, amount covered by uncompleted contracts-----	71,864.84
Amount (estimated) required for completion of existing project--	Indefinite.

(See Appendix E E 1.)

2. *Lock and Dam No. 37, Ohio River.*—The river and harbor act approved June 13, 1902, authorized the construction of this dam at a cost not to exceed \$1,050,000, and the river and harbor act of March 2, 1907, authorized the expenditure of \$100,000 in excess of amounts theretofore appropriated or authorized, "provided that the said lock and dam shall be constructed with a view to a navigable depth of nine feet." Of the continuing-contract authorizations \$330,000 is yet to be appropriated. Statements of actual construction are given in Reports of the Chief of Engineers for 1905, Appendix D D, pages 1816 to 1819, inclusive, and 1906, Appendix E E, pages 1564 to 1567, inclusive.

Work was carried on from July 1 until November 21, with interruptions from four freshets; work included cofferdam construction for Kentucky abutment and cross dam of lock coffer, excavation for walls and lock chamber, construction of lock wall foundations and monoliths, the laying of fixed ironwork and piping, and construction of sewers. About 467 linear feet of cofferdam was constructed, 3,945 cubic yards of ordinary, 1,696 cubic yards of deposit, and 2,175 cubic yards of rock excavation were accomplished. Ordinary filling to the amount of 5,904 cubic yards and stone filling to the extent of 33 cubic yards were done; 15,881 cubic yards of concrete masonry was laid; 285 linear feet of sewers was completed; 1,938 feet B. M. of oak timber was laid; 114,435 pounds of cast iron, 121,889 pounds of wrought iron and steel, and 535 pounds of steel castings were placed in the permanent work.

Under the provisions of contract, 534,956 pounds of ironwork was delivered at site and partial payment made thereon; 18,681½ barrels

of Atlas Portland cement were delivered under contract. Of this amount 16,547½ barrels have been used.

By authority of the Secretary of War an additional tract of land was secured, adjoining the United States property on the east. This land was secured in order to furnish a mooring ground for tows passing through the lock.

A supplemental agreement was entered into with the contractors for Dam No. 37, Ohio River, to cover changes in design in bear traps. This contract was dated June 22, 1907.

The total expenditure on account of work to June 30, 1907, exclusive of outstanding liabilities, is \$326,651.52.

It is proposed to apply the funds asked for the fiscal year 1909 for Lock and Dam No. 37, Ohio River, toward the completion of lock, navigable pass, bear traps, and machinery.

July 1, 1906, balance unexpended.....	\$360, 885. 85
Amount appropriated by sundry civil act approved March 4, 1907.....	270, 000. 00
	<hr/> 630, 885. 85
June 30, 1907, amount expended during fiscal year, for works of improvement.....	137, 537. 37
July 1, 1907, balance unexpended.....	493, 348. 48
July 1, 1907, outstanding liabilities.....	471. 97
	<hr/> 492, 876. 51
July 1, 1907, amount covered by uncompleted contracts.....	587, 639. 06
Amount (estimated) required for completion of existing project.....	330, 000. 00

{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907.....<sup>a</sup>\$230, 000. 00  
Submitted in compliance with requirements of sundry civil act of June 4, 1897.

(See Appendix E E 2.)

3. *Operating snag boats on the Ohio River below the Pennsylvania State line.*—The condition of the channel way of the Ohio, the necessity for continuous snag-boat work, and the benefits accruing therefrom to river commerce are plainly shown by the yearly reports of obstructions removed, which obstructions, if permitted to remain, would make navigation highly dangerous at ordinary stages and hazardous at any time.

The project for removing obstructions by a properly equipped snag boat was put in operation in 1876, the boat having been completed at a cost of \$125,125.24, and the expense of operating having been borne by appropriations for improving Ohio River until 1890. The river and harbor act of September 19, 1890, provided \$25,000 yearly for this purpose, and the act of June 3, 1896, increased the yearly appropriation to \$50,000.

The amount expended on this work during the fiscal year ending June 30, 1907, was \$34,439.74, the total expenditures up to the close of the present fiscal year, exclusive of outstanding liabilities, being \$544,023.37. For report upon operation of snag boats on the Ohio River in the State of Pennsylvania, see page 553, following.

<sup>a</sup> Of this amount \$230,000 is under contract authorization of 1902 and \$100,000 under that of 1907.

As far as practicable the removal of obstructions is carried on whenever permitted by the stage of water and the absence of dangerous ice; and during the last fiscal year the regular Ohio River snag boat *E. A. Woodruff* was in active service from July 1 to December 22, 1906, and from April 27 to June 30, 1907, traveling 6,316 miles and removing the following obstructions: One thousand and thirty-one snags, aggregating 4,754.47 tons; 4 rocks, measuring 306 cubic feet; 235 cords drift, and 50 wrecks, comprising 30 coal barges, 12 coal boats, 4 barges, various, 1 flatboat, and the remains of 3 steamboats.

The snag boat *Woodruff* is a powerful and finely equipped vessel that does admirable service during moderate stages of water, but can do little or nothing when the river is at a stage of less than 4 feet, though it is at such stages that snagging operations should be prosecuted most advantageously.

It is extremely important that snagging operations should be extended to cover these low-water periods, and to this end it is recommended that the yearly appropriation for snagging, as provided for by the act of June 3, 1896, be increased to \$100,000 for the fiscal year ending June 30, 1908, the additional \$50,000 to be used in the building and equipment of one light-draft combination snag and derrick boat, adapted for use at even extreme low-water stages. This boat would form a part of the regular snagging plant, and would be operated from the yearly appropriation made for that purpose.

(See Appendix E E 3.)

EXAMINATION AND SURVEY OF OHIO RIVER REQUIRED BY RIVER AND  
HARBOR ACT APPROVED MARCH 3, 1905.

Pursuant to a requirement in section 1 of the river and harbor act approved March 3, 1905, a Board of Engineers has been appointed to *examine the Ohio River and report, at the earliest date by which a thorough examination can be made, the necessary data with reference to the canalization of the river, and the approximate location and number of locks and dams in such river, with a view both to a depth of six feet and nine feet; and to include the probable cost of such improvement with each of the depths named, the probable cost of maintenance, and the present and prospective commerce of said river, etc.; also to examine the said river from the mouth of the Green River to Cairo, with a view to determining whether an increased depth can be maintained by use of dredges.* The Board's report will be duly submitted when received.

IMPROVEMENT OF MONONGAHELA RIVER, WEST VIRGINIA AND  
PENNSYLVANIA, AND OF ALLEGHENY RIVER AND PITTSBURG HAR-  
BOR, PENNSYLVANIA; CONSTRUCTION, ETC., OF LOCKS AND DAMS  
AND OPERATION OF SNAG BOATS ON OHIO RIVER IN PENNSYL-  
VANIA.

This district was in the charge of Maj. Wm. L. Sibert, Corps of Engineers, from July 1, 1906, to March 6, 1907, and of Maj. H. C. Newcomer, Corps of Engineers, since that date, the district officer having under his immediate orders First Lieut. E. N. Johnston, the entire year; First Lieut. George R. Spalding to November 1, 1906; Capt. F. C. Boggs to January 14, 1907; Capt. F. W. Altstaetter since

October 26, 1906; Capt. E. M. Adams since February 7, 1907, and Capt. A. E. Waldron since April 1, 1907. Division engineer, Col. G. J. Lydecker, Corps of Engineers.

1. *Monongahela River, West Virginia.*—The Monongahela River is formed by the junction of the Tygarts Valley and West Fork rivers, about 1 mile south of Fairmont, W. Va., and flows in a generally northerly direction about 128 miles to its junction with the Allegheny River at Pittsburg, Pa. The improvement of the portion in West Virginia is considered to extend down the river as far as Lock No. 8 at the mouth of Dunkards Creek, Pennsylvania, about 4 miles north of the Pennsylvania State line, or a total distance of about 41 miles.

Navigation on this portion of the river in its original condition was impeded at high water by swift currents, the fall per mile being about 2 feet. At low stages it was obstructed by shoals and numerous gravel and rock bars. Steamboat navigation was practicable at high stages as far upstream as Morgantown. Occasionally a boat could go as far upstream as Fairmont, and downstream navigation of flats and small rafts was practicable at medium and high stages.

The original project for this portion of the Monongahela River was adopted in 1872, and contemplated the construction of Locks and Dams Nos. 8 and 9. This project was completed on November 8, 1899, with the result that boats drawing 5.2 feet of water could navigate the river in low water as far upstream as Morgantown, W. Va., the river having previously been slackwatered from its mouth to Lock No. 8 by the Monongahela Navigation Company. The amount expended under this project was \$436,900.

The existing project, adopted by Congress July 13, 1892, provides for the construction of six locks and dams, Nos. 10 to 15, inclusive, between Morgantown and Fairmont, W. Va., at an estimated cost of \$1,275,000. Appropriations aggregating this amount have been made and the sum of \$107,463.86 was recovered from surety company on contract of C. I. McDonald for failure to complete Locks and Dams Nos. 10 to 15.

The amount expended under this project up to close of the fiscal year ending June 30, 1907, was \$1,313,681.45, including \$21.64 received from sales.

The condition of this work on June 30, 1907, was as follows:

*Nos. 10 to 15, inclusive.*—The locks and dams proper were completed and assigned to "Operating and care of canals," etc., in January, 1904. The lock houses and outbuildings have been completed, the lock grounds graded, and additional protection provided by strengthening the abutments and raising and lengthening the lower guide walls. Some further work is required on two of the abutments and the construction of one upper guide wall.

The completion of these six locks and dams extended slack-water navigation about 28 miles, from Morgantown to a point on the West Fork River 4 miles above Fairmont, W. Va., with a minimum navigable depth of 7 feet. The improvement should enable the people of the territory affected to transport coal, general freight, etc., almost uninterruptedly to market. The superstructure of the Baltimore and

Ohio Railroad bridge crossing the fifteenth pool, reported last year as an obstruction to traffic, was removed in December, 1906.

The greatest recorded flood height is 40 feet at Morgantown. Ordinary flood heights average about 22 feet on this portion of the river.

Traffic on this portion of the river is not heavy, but it has materially increased over that originally existing there. A daily line of packets plies the river between Pittsburg and Fairmont, and towboats operate as necessity requires. Since the opening of the locks there has been some development of coal mines and the shipment of coal by water in small quantities.

A statement of commerce and of the effect of the project on freight rates, so far as known, is given in the report for operating and care of locks and dams on Monongahela River, pages 546 and 547.

References to more extended information, reports of surveys, etc., are given on page 467 of the Annual Report of the Chief of Engineers for 1905.

July 1, 1906, balance unexpended.....	\$99, 777. 30
Amount received from sale of condemned property.....	21. 64
	<hr/>
	99, 798. 94
June 30, 1907, amount expended during fiscal year, for works of improvement.....	30, 994. 89
	<hr/>
July 1, 1907, balance unexpended.....	68, 804. 05
July 1, 1907, outstanding liabilities.....	432. 05
	<hr/>
July 1, 1907, balance available.....	68, 372. 00

(See Appendix F F 1.)

2. *Monongahela River, Pennsylvania.*—The improvement of this part of the river is considered to extend from Pittsburg to the mouth of Dunkards Creek, a distance of 87.5 miles. In its original condition, prior to 1840, it was navigable for steamboats only at high stages. A downstream navigation for light-draft flats and rafts was practicable at high and medium stages. The average fall per mile is about 0.9 foot and the minimum discharge about 160 cubic feet per second.

In 1833 Congress provided for a survey of the river from Pittsburg to Brownsville, a distance of about 57 miles. This survey was not followed by an appropriation for improving the river, and the legislature of Pennsylvania, by act of March 31, 1836, incorporated and authorized the Monongahela Navigation Company to improve the river from Pittsburg, Pa., to the Virginia State line, a distance of 91.5 miles. This company built seven locks and dams, producing slack water from Pittsburg to within 2 miles of the West Virginia State line.

The river and harbor act of June 3, 1896, authorized and directed the Secretary of War to institute and carry to completion proceedings for condemnation of all the property and appurtenances of the company. The property was acquired by the United States on July 7, 1897, at a cost of \$3,761,615.46.

The amount expended on original and modified projects prior to operations under existing project was \$3,769,073.88, including the purchase money.

The existing project, adopted in 1899, with subsequent modifications (see Annual Report 1906, p. 515), provides for the enlargement and improvement of Lock No. 6 and some additional structures at Lock No. 3, for the rebuilding of Locks Nos. 2, 3, and 5, using in each case two parallel chambers, each 56 by 360 feet, and fixed concrete dams with movable tops, and for the acquisition of necessary land and construction of certain improvements at Locks Nos. 5 and 6; all at a total estimated cost of \$2,194,605.

The amount expended up to the end of fiscal year ending June 30, 1907, was \$1,326,202.22.

Work is being carried on under continuing-contract appropriations at new Locks Nos. 3 and 5. The balance of the authorization remaining to be appropriated is \$500,000 (for Lock No. 5).

The condition of work on June 30, 1907, was as follows:

*Lock and Dam No. 2.*—The lock, power house, guard and guide walls, with the exception of upper 105 feet of upper guide wall, were built under contract. The abutment and dam were built by hired labor. The river lock has been in operation since August 15, 1905, and the land lock since March 5, 1906.

*Lock and Dam No. 3.*—The new lock, guard and guide walls, the power house, power plant, and two lock-keepers' houses were completed under contract. The abutment was built by hired labor; the dam was 30 per cent completed by hired labor.

*Lock and Dam No. 5.*—Plans and specifications for the new lock and dam have been completed. Actual construction work has not been commenced.

*Locks 3, 6, and floating plant.*—All of the necessary structures at Lock No. 3, and the improvements contemplated at Lock No. 6, have been nearly completed. All of the floating plant provided for in the existing project, consisting of a dredge and two dump scows and repair steamer with snagging appliances, has been completed and put in service.

The greatest recorded flood height is 44 feet at Brownsville. Ordinary flood heights average about 30 feet on this portion of the river.

The traffic of the river is hampered and restricted by insufficient capacity and inconvenience at the locks. This will not be overcome until the enlargement of Locks 1, 4, and 5 has been accomplished.

A statement of commerce and of the effect of the project on freight rates, so far as known, is given in the report for operating and care of locks and dams on Monongahela River, pages 546 and 547.

It is proposed to apply the \$400,000 estimated as a profitable expenditure in fiscal year ending June 30, 1909, to work on new Lock and Dam No. 5 under continuing contract authorized by the river and harbor act of March 2, 1907.

A list of references to reports of examinations and surveys and other items of interest concerning this river are given on page 469 of Annual Report of the Chief of Engineers for 1905.

## CONSOLIDATED.

July 1, 1906, balance unexpended.....	\$484,097.54
Received from sale of condemned property.....	257.32
Amount appropriated by river and harbor act approved March 2, 1907.....	256,042.00
	<hr/>
June 30, 1907, amount expended during fiscal year, for works of improvement.....	740,396.86
	<hr/>
July 1, 1907, balance unexpended.....	368,660.10
July 1, 1907, outstanding liabilities.....	15,694.04
	<hr/>
July 1, 1907, balance available.....	352,966.06
	<hr/>
July 1, 1907, amount covered by uncompleted contracts.....	20,216.51
Amount (estimated) required for completion of existing project....	500,000.00
	<hr/>
{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907.....	400,000.00
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

## REBUILDING LOCK NO. 2.

July 1, 1906, balance unexpended.....	\$19,152.40
Amount received from sale of condemned property.....	9.21
	<hr/>
June 30, 1907, amount expended during fiscal year, for works of improvement.....	19,161.61
	<hr/>
July 1, 1907, balance unexpended.....	15,379.24
July 1, 1907, outstanding liabilities.....	3,782.37
	<hr/>
July 1, 1907, balance available.....	66.06
	<hr/>
July 1, 1907, balance available.....	3,716.81

## REBUILDING LOCK NO. 3.

July 1, 1906, balance unexpended.....	\$453,291.21
Amount received from sale of condemned property.....	248.11
	<hr/>
June 30, 1907, amount expended during fiscal year, for works of improvement.....	453,539.32
	<hr/>
July 1, 1907, balance unexpended.....	354,755.58
July 1, 1907, outstanding liabilities.....	98,783.74
	<hr/>
July 1, 1907, balance available.....	11,285.47
July 1, 1907, amount covered by uncompleted contracts.....	87,498.27
	<hr/>
July 1, 1907, amount covered by uncompleted contracts.....	20,216.51

## REBUILDING LOCK NO. 5.

Amount appropriated by river and harbor act approved March 2, 1907.....	\$256,042.00
June 30, 1907, amount expended during fiscal year, for works of improvement.....	1,601.94
	<hr/>
July 1, 1907, balance unexpended.....	254,440.06
July 1, 1907, outstanding liabilities.....	892.51
	<hr/>
July 1, 1907, balance available.....	253,547.55
Amount (estimated) required for completion of existing project....	500,000.00
	<hr/>

{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement in addition to the balance unexpended July 1, 1907.....	400,000.00
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897.	



## LOCKS NOS. 3, 6, ETC.

July 1, 1906, balance unexpended-----	\$3, 803. 93
July 1, 1907, balance unexpended-----	3, 803. 93
July 1, 1907, outstanding liabilities-----	3, 450. 00
July 1, 1907, balance available-----	353. 93

## LOCKS NOS. 5 AND 6.

July 1, 1906, balance unexpended-----	7, 850. 00
July 1, 1907, balance unexpended-----	7, 850. 00

(See Appendix F F 2.)

3. *Operating and care of locks and dams, Monongahela River.*—Statements of the original condition of the Monongahela River are contained in the summaries for Monongahela River, West Virginia and Pennsylvania. The slack-water system of the Monongahela River comprises 15 locks and dams. Locks Nos. 1 to 4, inclusive, are double locks; 5 to 15 are single locks. A table giving the dimensions of the locks, lengths of dams, and other data is given in Appendix F F 3.

The dams extend slack water to a point on West Fork River 4 miles above Fairmont, W. Va., or a total distance of about 131 miles above the mouth of the Monongahela River at Pittsburg. Controlling depths at normal pool stages on the sills at the different old locks below Morgantown vary from 4 to 6.7 feet; on the new locks above that place they are uniformly 7 feet. During low stages of water depths of 7.5 to 8 feet are maintained below Dam No. 6 by placing flashboards on the dams.

Locks Nos. 1 to 7, inclusive, have been under operation and care since July 7, 1897, when they were purchased from the Monongahela Navigation Company; No. 8 since November 8, 1889; No. 9 since 1879, and Nos. 10 to 15, inclusive, since January, 1904.

The total amount expended for operating and care to June 30, 1907, was \$2,190,206.66. The amount expended during the fiscal year ending June 30, 1907, was \$242,365.62.

Necessary repairs were made to the locks and dams. The most notable work of repair during the year was that made to Dam No. 8, and consisted in rebuilding about 80 feet of the dam next to the lock, which had washed out almost to its base. The work was done by the regular hired-labor force during the winter months and was interfered with repeatedly by floods and moving ice. The cost of materials and labor, including expenses of derrick and dredge boats, was about \$6,200.

The locks were operated throughout the year except when closed for limited periods for repairs and during floods and ice.

The total number of lockages at the 15 locks aggregated 87,945, giving a total commerce through individual locks amounting to 34,130,877 tons and 268,709 passengers. Much of this commerce, of course, moved through several locks. Taking only the aggregate of the greatest items of the different kinds of freight passing up and down at any single lock, plus the coal mined and shipped in pools 1 and 2, which amount is manifestly less than the real movement of commerce, the total commerce of the Monongahela River for the year amounted to 11,817,128 tons and 47,216 passengers.

The effect on freight rates of the slack-water system of the Monongahela is very great. This is true for all manner of products, and particularly so for coal. For an average haul of 50 miles on the Monongahela River the price of coal delivered by river is \$1.25 per ton, as compared with \$1.40 per ton delivered by rail, making the river freight rate 15 cents per ton cheaper. As the haul increases the advantage of the river advances rapidly. As an example, the river freight rate on coal to a point 12 miles below Pittsburgh is 2.5 mills per bushel, or 6.25 cents per ton, in barge-load lots, while the rail freight rate to the same point is 40 cents per ton, a difference in favor of river of 33.75 cents per ton, and this difference exists in spite of the fact that part of this river haul is on the unimproved Ohio River. The effect on freight rates beyond the above, due to the rebuilding of Locks and Dams 2 and 3, will not be felt until the enlargement of Locks Nos. 1, 4, and 5 is accomplished, when larger cargoes will be towed by steamers and the freight rate reduced accordingly.

(See Appendix F F 3.)

4. *Allegheny River, Pennsylvania, open-channel work.*—The Allegheny River rises in northern Pennsylvania and flows northwestward into New York, and thence in a southerly direction to its junction with the Monongahela River at Pittsburgh. The average fall per mile of the navigable portion is about 2.2 feet and the minimum discharge at Pittsburgh is about 1,440 cubic feet per second. In its original condition the Allegheny River abounded in obstructions, such as bowlders, snags, islands, bars, and widespreading shoals, all of which rendered navigation at best hazardous and practicable only at such high stages of water as would enable craft to clear the obstructions.

The present project was adopted in 1878 and 1880 and contemplates the removal of the bowlders and snag obstructions and the construction of low dams and dikes to close secondary channels and concentrate the low-water flow on shoals.

The amount expended under this project to June 30, 1907, was \$262,108.92, fully one-half of which was applied to maintenance.

The work that has been done enables navigators to operate safely on stages from 2 to 3 feet lower than formerly.

The present condition of the channel is generally satisfactory, having been largely cleared of the more objectionable obstructions, but to maintain its condition it is necessary to annually remove any bowlders or snags brought in by the tributaries or carried along by ice and freshets. The dikes and dams are also becoming old and require frequent repairs.

The greatest recorded flood height is 36.6 feet at Herr Island dam. Ordinary flood heights average about 30 feet.

Except on the lower 25 miles of the river the principal traffic is the downstream transportation of timber and lumber rafts, new coal-boat bottoms, barges and flats, usually loaded with tan bark, lumber, posts, railroad ties, and other timber products, and the towage of gravel, stone, sand, etc. Steamboating is not now conducted to any material extent above Kittanning.

The annual commerce of the river above slack-water improvements in course of construction is about 400,000 tons, extending over 230 miles from Tarentum, Pa., to Olean, N. Y.

The effect of this project has not decreased the freight rates on this material noticeably, as the depth of water has not been increased by the improvements, although the hazard of boating has been decreased greatly.

More detailed information, reports of surveys, etc., are given in the following Annual Reports of the Chief of Engineers: 1899, page 2411; 1902, page 1901, and 1905, page 1862.

July 1, 1906, balance unexpended.....	\$4,247.87
June 30, 1907, amount expended during fiscal year, for maintenance of improvement .....	1,356.79
July 1, 1907, balance unexpended.....	2,891.08
July 1, 1907, outstanding liabilities.....	3.00
July 1, 1907, balance available.....	2,888.08

(See Appendix FF 4.)

*5. Allegheny River, Pennsylvania, construction of locks and dams.*—Prior to the completion, in 1885, of the Davis Island dam in the Ohio River, 5 miles below its head, it was impossible to navigate the Allegheny River with steam craft of lightest draft during low-water periods, which frequently continued for months at a time. Since then a navigable depth of 8 feet has been afforded by that dam, when raised, to Garrison ripple, 2 miles up the stream.

The present project for lock and dam construction, originally adopted in 1890 and subsequently extended in 1896, provides for the construction of three locks and dams, extending slack water from the mouth to Tarentum, a distance of 25 miles. Dam No. 1 is movable, of Chanoine type, with bear-trap weirs. Dams Nos. 2 and 3 are both fixed, the former being built of concrete on pile foundation and the latter of crib construction. The lock chamber at No. 1 is 55 feet by 286 feet 2 inches; at Nos. 2 and 3, 56 feet by 289 feet 6 inches. The estimated cost of the work is \$1,658,226.63, including \$10,000 for restoration of bank, etc., below Dam No. 3.

The amount expended to June 30, 1907, was \$1,347,869.55; of this amount \$10,000 was expended for maintenance.

The work is being done partly under continuing contract, and the total authorization has been appropriated.

The condition of the work on June 30, 1907, was as follows:

*Lock and Dam No. 1 (Herr Island), about 1½ miles from the mouth.*—This work was built under contract and has been in operation since January 1, 1903. One double lock-master's house has also been built under contract.

*Lock and Dam No. 2 (Aspinwall), 7 miles from the mouth.*—The lock has been built under contract and has been in operation since November 10, 1906. The abutment and dam have been partially built under contract. It is expected that they will be completed during the present season.

*Lock and Dam No. 3 (Springdale), about 17 miles from the mouth.*—The lock was built under contract and has been in operation since September, 1904. The abutment and dam were built under contract. In January, 1907, during a moderate flood stage, the abutment failed and a portion of the dam had to be blown up to limit the resulting damage to private property. Two lock houses have been constructed under contract.

Pool No. 1 provides a navigable depth of 5 to 6 feet. Dams Nos. 2 and 3 must be completed before any appreciable increase of depth will be obtained in their respective pools.

The greatest recorded flood height is 36.6 feet at Herr Island dam. Ordinary flood heights average about 30 feet.

For the calendar year 1906 the commerce reported on that part of the river under the improvement for slack-water navigation was 2,583,757 tons of freight and 4,475 passengers.

The completion of these locks and dams will be of immense benefit to the manufacturing plants along the banks of the Allegheny River within their reach, by reason of connecting them with the harbor of Pittsburg and with the coal fields of the Monongahela River.

The effect of the project on freight rates is given in report on operating and care of locks and dams on Allegheny River.

July 1, 1906, balance unexpended.....	\$290,303.85
Amount appropriated by river and harbor act approved March 2, 1907.....	235,000.00
Amount received from sale of blueprints.....	18.45
	<hr/>
June 30, 1907, amount expended during fiscal year, for works of improvement.....	525,322.30
	<hr/>
July 1, 1907, balance unexpended.....	214,794.52
July 1, 1907, outstanding liabilities.....	310,527.78
	<hr/>
July 1, 1907, balance available.....	81,525.55
	<hr/>
July 1, 1907, amount covered by uncompleted contracts.....	229,002.23
	<hr/>
	79,380.70

(See Appendix F F 5.)

6. *Operating and care of locks and dams, Allegheny River, Pennsylvania.*—Statement of the original condition of the Allegheny River is contained in the preceding summary for Allegheny River, Pennsylvania.

Locks Nos. 1, 2, and 3 were under the appropriation for operating and care at the end of the fiscal year. Dimensions of locks and other data are given in Appendix F F 6.

Dam No. 1 is movable and is the first to be completed in a series of three authorized by Congress for the Allegheny River; its pool provides a navigable depth of 5 to 6 feet for a distance of about 5.5 miles. Dams Nos. 2 and 3 are both fixed, the former being built of concrete on pile foundation and the latter of crib construction. Dam No. 2 is only partially completed; when finished it will form a pool about 10 miles long. Dam No. 3 was practically completed in 1904, but was partly destroyed in January, 1907; its pool, when restored, will extend slack water to Natrona, a distance of about 8 miles.

Lock No. 1 has been under operating and care since January 1, 1903; No. 2 since November 10, 1906, and No. 3 since November 29, 1904.

The total amount expended for operating and care to June 30, 1907, was \$158,135.36. The amount expended during fiscal year 1907 was \$82,998.35.

The locks and dams were operated throughout the year as occasion required.

By far the heaviest expenditure was made in limiting the damage to private property when the abutment of Dam No. 3 failed in January, 1907. The rapid caving of the bank, involving the destruction of a number of houses and threatening the large plate-glass mirror

works a short distance below the dam, made it necessary to secure large quantities of stone under emergency conditions and to destroy a portion of the dam. The total amount expended in this connection was about \$80,000, including outstanding liabilities.

The traffic through locks and dams, Allegheny River, during the fiscal year 1907, was as follows: Lock and Dam No. 1, 585,409 tons and 1,696 passengers; Lock and Dam No. 2, 1,915,436 tons and 232 passengers; Lock and Dam No. 3, 82,912 tons and 2,547 passengers. The tons represent short tons of 2,000 pounds.

The operation of the locks and dams on the Allegheny River, providing a system of slack-water navigation in connection with Pittsburgh Harbor, will tend to give manufacturing plants in this section the benefit of the cheap river rates on coal and other supplies. This benefit, however, can not be realized to any considerable extent until the low bridges on the lower Allegheny River are raised sufficiently to remove the very serious obstruction to navigation that they now present.

(See Appendix F F 6.)

*7. Construction of locks and dams in Ohio River, Pennsylvania (40.5 miles).—*The Ohio River, Pennsylvania, in its original condition had a low-water channel depth varying from 1 foot at Pittsburgh to 2 feet at the Ohio State line, the average slope being about 1.25 feet per mile and the minimum discharge at the head about 1,600 cubic feet per second. Under the original project for open-river improvement, work was conducted on this portion of the river at a number of shoals.

Under the original project for lock and dam construction, adopted in 1875, Dam No. 1 was begun in 1877 and completed in 1885, at a cost of \$940,000. The present project, in its original form, was adopted by Congress September 19, 1890, and, with subsequent modifications, provides for the construction of Locks and movable Dams Nos. 2, 3, 4, 5, 6, and 7, so as to secure a navigable depth of 9 feet in the pools formed thereby, the locks to have available dimensions of 110 by 600 feet, at a total estimated cost of \$6,321,376. Appropriations aggregating \$5,369,376 have been made, and \$15,233.54 has been realized from other sources.

The amount expended under present project to the close of the fiscal year ending June 30, 1907, was \$4,851,333.90.

The work is being done partly under continuing-contract system, and the total authorization has been appropriated.

The condition of work on June 30, 1907, was as follows:

*Lock and Dam No. 2.*—The lock and dam were practically completed and have been in operation since October 13, 1906.

*Lock and Dam No. 3.*—The lock, including gates and operating gearing, was completed; the dam was completed, except the placing of 69 props and 132 wickets, and the construction of two bear-trap gate foundations was also nearly completed. The lower leaf of one of the bear-trap gates, 93 feet in length, was nearly finished, and that of the other bear-trap gate about one-fourth constructed. To meet the requirements of 9-foot navigation, the land wall of the lock was raised 30 inches and the lower guide wall 4 feet. A power house and two lock houses were completed. The lock-operating power plant, consisting of two 85-brake horsepower gas engines and two

*Lock and Dam No. 4.*—The lock was completed and the gate-operating machinery installed for the upper gate; 424 feet of navigable pass was built and the movable parts placed in 170 feet of same; the three piers were completed; the Chanoine weir, including movable parts and the protection crib, was finished; 80 per cent of the abutment was built; the foundation of one of the bear traps was finished and one-half of the lower leaf erected preparatory to riveting; the foundation course of concrete in the other bear trap was placed and the foundation irons set; the machinery and piping for operation of river-wall valves were installed; I beams and cover plates were placed over the lock-gate recesses; preparatory to elevation of lock for 9-foot navigation, the stone coping and timber facing were removed from the land wall. A power house and two lock houses were completed.

*Lock and Dam No. 5.*—The lock was practically completed; the navigable pass, abutment and weirs, except one bear-trap gate, were completed; work on completion of dam and bear-trap gates was under way. A power house and two lock houses were completed.

*Lock and Dam No. 6.*—The lock and dam were completed for 6-foot navigation and put in operation August 3, 1904. The plant for lowering the sill for 9-foot navigation was being assembled, and the construction of a cofferdam for unwatering the lock was in progress.

*Lock and Dam No. 7.*—The site for this dam has been secured. The preparation of plans for the lock and dam was begun, but as no further appropriation has been made by Congress for this work, no work is now being done.

Dams Nos. 1, 2, and 6 form pools in the Ohio River having lengths of 4.72, 4.44, and 5 miles, respectively. The completion of Dams Nos. 3, 4, and 5 will add 14.7 miles to the system, making it continuous from Pittsburg to Merrill, Pa., a distance of about 28.9 miles.

The greatest recorded flood height is 34.2 feet at Davis Island dam. Ordinary flood heights average about 28 feet on this portion of the river.

A statement of commerce and of the effect of the project on freight rates, so far as known, is given in the report for operating and care of locks and dams, Ohio River, page 553.

Reference to more detailed information, reports of surveys, etc., are given on page 522 of the Annual Report of the Chief of Engineers for 1906.

## CONSOLIDATED.

July 1, 1906, balance unexpended	\$1, 486, 454. 58
Amount received from sale of blueprints	77. 61
Amount appropriated by river and harbor act approved March 2, 1907	70, 000. 00
Amount received from sale of land and condemned property	14, 911. 23
	<hr/> 1, 571, 443. 42
June 30, 1907, amount expended during fiscal year:	
For works of improvement	\$1, 037, 817. 78
By transfer settlement	350. 00
	<hr/> 1, 038, 167. 78
July 1, 1907, balance unexpended	533, 275. 64
July 1, 1907, outstanding liabilities	21, 533. 92
	<hr/> 511, 741. 72
July 1, 1907, balance available	
July 1, 1907, amount covered by uncompleted contracts	382, 877. 18
Amount (estimated) required for completion of existing project	952, 000. 00

## DAMS NOS. 2, 3, 4, AND 5.

July 1, 1906, balance unexpended.....	\$1,475,879.70
Amount received from sale of blueprints.....	77.61
Amount received from sale of land and condemned property.....	14,911.23
	<hr/> 1,490,868.54
June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$1,035,768.92
By transfer settlement.....	350.00
	<hr/> 1,036,118.92
July 1, 1907, balance unexpended.....	454,749.62
July 1, 1907, outstanding liabilities.....	16,615.99
	<hr/> 438,133.63
July 1, 1907, balance available.....	438,133.63
July 1, 1907, amount covered by uncompleted contracts.....	339,587.18

## DAM NO. 6.

July 1, 1906, balance unexpended.....	\$3,773.69
Amount appropriated by river and harbor act approved March 2, 1907.....	70,000.00
	<hr/> 73,773.69
June 30, 1907, amount expended during fiscal year, for works of improvement.....	1,320.40
July 1, 1907, balance unexpended.....	72,453.29
July 1, 1907, outstanding liabilities.....	4,917.93
	<hr/> 67,535.36
July 1, 1907, balance available.....	67,535.36
July 1, 1907, amount covered by uncompleted contracts.....	23,290.00

## DAM NO. 7.

July 1, 1906, balance unexpended.....	\$6,801.19
June 30, 1907, amount expended during fiscal year, for works of improvement.....	728.46
July 1, 1907, balance unexpended.....	6,072.73
Amount (estimated) required for completion of existing project.....	952,000.00

(See Appendix F F 7.)

8. *Dredging Ohio River, Pennsylvania.*—An allotment of \$20,800 was made June 12, 1905, from the appropriation of \$300,000 made by act of March 3, 1905, for the general improvement of the Ohio River, for the removal of the bar in upper approach to Lock No. 6. This bar was removed by the excavation of 35,161 cubic yards of material at a contract cost of 19 cents per cubic yard. On August 30, 1905, a reallocation of \$10,350 from the allotment for dredging pool No. 6 was made for dredging in pools Nos. 3 and 4, Ohio River. Under this allotment the channel at Whites riffle, above Lock No. 3, was straightened out. The total amount of material handled was 36,162 cubic yards.

The amounts expended on these works to June 30, 1907, are as follows:

Dredging pools Nos. 3 and 4.....	\$4,941.45
Dredging pool No. 6.....	8,693.16
Total.....	<hr/> 13,634.61
July 1, 1906, balance unexpended.....	\$10,768.55
Amount returned to general improvement fund.....	2,500.00
	<hr/> 8,268.55
June 30, 1907, amount expended during fiscal year, for works of improvement.....	3,603.16
July 1, 1907, balance unexpended.....	<hr/> 4,665.39

(See Appendix F F 8.)

9. *Operating snag boats on Ohio River in the State of Pennsylvania.*—The project adopted July 27, 1905, provides for the removal of snags, wrecks, and similar obstructions in portion of the Ohio River in the State of Pennsylvania. This work was carried on under allotments made from the appropriation for operating snag boats on Ohio River.

The amount expended on this work to June 30, 1907, is \$3,115.23, of which \$1,324.39 was expended during the past fiscal year.

There were removed during the year 3 fuel flats, 2 coal barges, 1 coal boat, and the dismantled hull of the old U. S. steamer *Slackwater*.

(See Appendix F F 9.)

10. *Operating and care of locks and dams, Ohio River, Pennsylvania.*—Statement of the original condition of the Ohio River is contained in the summary for Ohio River, Pennsylvania.

Locks and Dams Nos. 1, 2, and 6 were under the appropriation for operating and care at the end of the fiscal year. The dams are all movable and are the first ones to be completed in the series that is projected for the improvement of the Ohio River. The dimensions of the locks, with other data, are given in Appendix F F 10.

Dam No. 1, at Davis Island, was designed to give a depth of 6 feet in Pittsburg Harbor, which has since been increased to 10 feet over certain portions of the harbor by dredging. Dams Nos. 2 and 6 are designed to give navigable depths of 9 feet in their respective pools. The aggregate length of these pooled portions of the river is 14.16 miles.

Dam No. 1 was placed under operating and care October 7, 1885; Dam No. 6, August 3, 1904; and Dam No. 2, October 13, 1906.

The total amount expended for operating and care to June 30, 1907, was \$587,308.97. The amount expended during the fiscal year ending June 30, 1907, was \$56,027.44.

Dam No. 1 was up during the fiscal year five times, aggregating 142 days; Dam No. 2, three times, aggregating 18 days; and Dam No. 6, four times, aggregating 90 days.

The locks were operated as occasion required and necessary repairs made for maintenance of the works.

The traffic through Locks and Dams Nos. 1, 2, and 6, Ohio River, for the fiscal year 1907, as measured by the commerce through Lock and Dam No. 1, amounted to 3,319,631 tons of 2,000 pounds.

The effect of the project on freight rates has been partly discussed in the report for operating and care of locks and dams, Monongahela River.

Davis Island dam, forming, as it does, the pool of Pittsburg Harbor, has lent its great part to the general effect on freight rates to and from Pittsburg. The effect on rates of the operation of Dams Nos. 2 and 6 is not felt at present, except locally, but is expected to become more pronounced upon the completion of Locks Nos. 3, 4, and 5, which will increase from 25 to 50 per cent the number of days in the year on which tows may be moved down the river from Pittsburg.

The great future benefit of the above project will be felt only when the slack-water system is extended far enough down the Ohio River to permit continuous navigation during all but the winter season. This improvement it is confidently expected will cause a saving in freight rates over the present rail rates on such produce as coal, iron, steel, sugar, timber, molasses, tobacco, etc., of over 3 mills per ton



mile to the 8,000,000 people living in territory commercially contiguous to the Ohio and Mississippi systems.

(See Appendix F F 10.)

11. *Harbor at Pittsburg, Pa.*—This harbor comprises that portion of the Ohio River lying above Davis Island dam, a length of 4.7 miles; that portion of the Allegheny River lying between its mouth and Aspinwall, a length of 7 miles, and that portion of the Monongahela River lying between its mouth and McKeesport, a distance of 15.5 miles; total length of harbor, 27.2 miles. That portion of the harbor most used as such, and called the lower harbor, lies between the Davis Island dam and Dams No. 1 on the Allegheny and Monongahela rivers and measures 8 miles of river. In its original condition the lower-harbor depths were from 3 to 4 feet on natural mean low river, and very often still lower stages caused suspension of navigation.

Since the completion of Davis Island dam, in 1885, the maximum draft which could be carried over the shoalest place was scant 8 feet at pool stage. Parts of the channel and harbor are from 10 to 12 and from 16 to 20 feet in depth. The average widths of the harbor at pool-full surfaces are: On the Ohio, about 1,100 feet; on the Allegheny, about 930 feet, and at different parts of the Monongahela, from 750 to 950 feet. The capacity of the harbor is impaired by shoal places and high dumps projecting from the banks. The use for harbor purposes of that portion of the harbor in the Allegheny River above the Sixth Street Bridge is practically nullified by the low bridges on that part of the stream. The clear heights of these bridges above their respective pool surfaces are from  $27\frac{1}{2}$  to  $35\frac{1}{2}$  feet. The least height, with chimneys down, of the packets that ply between Pittsburg and points on the Ohio, Kanawha, and Muskingum rivers is 45 feet. The average height of the Ohio River towboats, with chimneys down, is 44 feet. The height of a suitable packet for the Allegheny River is about 33 feet, and of a suitable towboat, about 28 feet. The result is that practically none of the coal and iron or steel products intended for southern shipments have been loaded or harbored in the Allegheny River. The removal of the Union Bridge at the mouth of the river, now in progress, will open up this portion of the harbor as far as the Sixth Street Bridge, a distance of about one-half mile.

In 1858 the State of Pennsylvania, through a board of commissioners, made a detailed survey of the rivers at and near Pittsburg and laid down on the maps high and low water lines intended to define the banks and limit the use of the same by riparian proprietors. These lines were referred to stone monuments on the ground. No means, however, were provided for preserving the monuments nor for preventing filling in the river beyond these lines.

In 1894 a Board of Engineer officers recommended certain harbor lines for the harbor of Pittsburg, from the Davis Island dam to Brilliant, Allegheny River, and to Homestead, Monongahela River. The recommended lines generally followed the actual banks as they existed at that time. These lines were approved by the Secretary of War January 29, 1895. An extension of these lines on the Monongahela River from Homestead to McKeesport was approved by the Secretary of War April 3, 1902.

The original project for improvement was adopted by the river and harbor act of March 3, 1899, and provided, with subsequent modi-

fications made during the progress of the work, for dredging a channel through the lower harbor (below Dams No. 1 on the Allegheny and Monongahela rivers) where needed 10 feet deep at pool and 500 feet wide below Smithfield Street Bridge, Monongahela River, and of less width above this bridge and in the Allegheny River, limited by lines from ends of channel spans of the adjoining bridges, except at the Pan Handle Railroad Bridge, where the dredged channel, under modified project, was to have a width of 570 feet, including two channel spans; for raising the old riprap dam across Brunot Island back channel, Ohio River; for removing abandoned structures and unauthorized and obstructive fillings projecting from the banks beyond the harbor lines; for marking of harbor lines, and for inspecting and patrolling the harbor. Appropriations aggregating \$110,662.90 were made and expended on this work.

The existing project provides for maintenance of the harbor at an annual estimated cost of \$10,000. The amount expended under this project to June 30, 1907, was \$33,408.64.

The greatest recorded flood height is 35 feet at Pittsburgh. Ordinary flood heights average about 20 feet.

The principal commercial uses of the harbor are the mooring of coal fleets awaiting a rise in the Ohio for proceeding to destination on that river or on the lower Mississippi, the mooring of timber rafts and boat bottoms coming down the Allegheny River on rises, the delivery of coal and other materials to mills, furnaces, steel plants and yards, and the accommodation of the several packet lines plying on the three rivers and whose routes terminate at the harbor. Besides coal, considerable quantities of steel rails, cotton ties, sheet iron, wire, nails, etc., are shipped by barges to the lower-river markets.

*Commercial statistics.*

Calendar year.	Products.	Passen- gers.	Calendar year.	Products.	Passen- gers.
	<i>Tons.</i> <sup>a</sup>			<i>Tons.</i> <sup>a</sup>	
1900.....	8,141,451	884,415	1904.....	9,373,448	604,477
1901.....	10,916,489	817,800	1905.....	12,269,020	603,716
1902.....	12,252,405	996,500	1906.....	12,927,975	271,450
1903.....	12,240,360	702,269			

<sup>a</sup> 2,000 pounds.

The improvement of this harbor is so closely connected with the slack-water system of the rivers emptying into it that it might well be said that, as far as effect in freight rates is concerned, this project is one and the same as the projects for the improvement of said rivers.

References to reports of establishment of harbor lines and projects for maintaining this harbor are given in Annual Reports of the Chief of Engineers for 1905, page 474, and 1906, page 520.

July 1, 1906, balance unexpended.....	\$940. 58
Received by transfer settlement.....	4, 000. 00
Amount appropriated by river and harbor act approved March 2, 1907.....	10, 000. 00
Received from sale of blueprints.....	20. 89
	<hr/>
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	14, 961. 47
	<hr/>
July 1, 1907, balance unexpended.....	9, 349. 22
July 1, 1907, outstanding liabilities.....	5, 612. 25
	<hr/>
July 1, 1907, balance available.....	477. 73
	<hr/>
July 1, 1907, balance available.....	5, 134. 52

(See Appendix F F 11.)

CONSTRUCTION OF LOCKS AND DAMS IN OHIO RIVER BETWEEN THE PENNSYLVANIA STATE LINE AND CINCINNATI, OHIO, AND IMPROVEMENT OF KANAWHA AND LITTLE KANAWHA RIVERS, WEST VIRGINIA.

This district was in the charge of Maj. Geo. A. Zinn, Corps of Engineers, to January 16, 1907, and from April 19 to May 14, 1907, and in the charge of Capt. F. C. Boggs, Corps of Engineers, from January 16 to April 19, 1907, and since May 14, 1907. Division engineer, Col. G. J. Lydecker, Corps of Engineers.

*1. Locks and dams in Ohio River between the Pennsylvania State line and Cincinnati.*—A general description of the Ohio River is contained in the Annual Report of the Chief of Engineers for 1896, page 2062. The system of improvement of this river by movable dams was approved by Congress in the act of March 3, 1875 (construction of dam at Davis Island—first dam below Pittsburg). The act of September 19, 1890, provided for the construction of a dam at or near Beaver, Pa., known as No. 6. The above represent practically the original projects for the slack-water system of the Ohio. The original project for Dams Nos. 8 to 18, inclusive, is contained in Annual Report of the Chief of Engineers for 1899, page 2361, and that for Dams Nos. 19 and 26 in Annual Report of the Chief of Engineers for 1902, page 1867.

Congress in the river and harbor act of March 3, 1905, made provision for 9-foot navigation in the pools formed by Dams Nos. 2, 3, 4, 5, and 6, and for an examination of and report on the river by a Board of Engineers with regard to the method and means of improvement which will meet the demands of traffic, present and prospective.

The river and harbor act of March 2, 1907, makes provision for a navigable depth of 9 feet at Dams Nos. 8, 11, 13, 18, and 26, and for increased cost as follows: Dam No. 8, \$1,211,845; Dam No. 11, \$1,158,343; Dam No. 13, \$1,286,778; Dam No. 18, \$933,000; and Dam No. 26, \$1,200,000. The increased depth at Dam No. 19 has not been authorized and the estimate of cost remains at \$950,000.

When the dams are completed they will provide a navigable depth of 9 feet at intervals between Pittsburg, Pa., and Gallipolis, Ohio.

Continuing contracts have been authorized for carrying on the following works, the balance of the authorization remaining to be appropriated being set opposite:

Dam No. 8.....	\$500,000
Dam No. 11.....	500,000
Dams Nos. 13 and 18.....	455,000
Dam No. 26.....	965,000

The following is a statement of the condition of the works:

*Dam No. 8.*—Work at this site was confined to the lock and guide walls and esplanade. The lock and guide walls were completed for 6-foot navigation, and are being raised to meet the 9-foot requirement of the last river and harbor act; paving of lock chamber was finished. About 85 per cent of the work contracted for is completed. Plans for the dam are in preparation.

*Dam No. 11.*—Progress on the lock and guide walls, to which the work at this site is limited, has been very unsatisfactory. The following is the condition of the work: Entire land wall, 305 linear feet of

river wall, walls for upper and lower gate recesses, and 215 linear feet of lower guide wall are completed, except additional height to provide for a 9-foot navigable depth; 160 linear feet of lock chamber paved for a width of 55 feet; and considerable foundation work for walls, gate tracks, etc., placed. Not over 45 per cent of the work contracted for is completed.

*Dam No. 13.*—The lock walls, part of the guide walls, paving of lock chamber, and a portion of the power-house foundation are completed.

Under a contract for the construction of the dam, the following portions have been completed: Retaining wall, abutment, foundations for both bear traps, Pier A, Pier B, and 179 linear feet of navigation pass (except wickets). Fully 40 per cent of the work contracted for is completed.

*Dam No. 18.*—Masonry of lock and filling of esplanade are completed.

Progress under contract for construction of dam has been very unsatisfactory. The contractor having failed, work is being carried on by the receiver. At the close of the fiscal year the following portions were completed: Abutment, 569 linear feet of navigation pass (except the placing of 70 wickets) and part of the foundations for east bear trap and Pier C. Less than 50 per cent of the work contracted for is completed.

*Dam No. 19.*—All the land for this site is owned by the United States.

*Dam No. 26.*—Preparations were made for locating the site.

The amount expended on the above works to June 30, 1907, is as follows:

Dam No. 8.....	\$405, 349. 14
Dam No. 11.....	234, 134. 45
Dam No. 13.....	563, 170. 07
Dam No. 18.....	466, 330. 02
Dam No. 19.....	17, 011. 64
Dam No. 26.....	42. 35
Total .....	1, 686, 037. 67

The canalization of this section of the river is not far enough advanced to benefit navigation, and therefore has had no effect upon freight rates.

For commercial statistics see reports for improving Ohio River and operating and care of Davis Island dam.

Sufficient funds should be made available for completing the dam at No. 8, as the lock is practically finished.

At No. 11 the work is not so far advanced, but it is believed that better results can be obtained by having sufficient funds in hand to complete a work before the contract is let. It is proposed to advertise for building the dam early next season.

The amount stated for Dam No. 13 is required to continue the construction work at that site, especially the construction of buildings, etc.

The statement made in the paragraph relative to Dam No. 11 applies also to work at Dams Nos. 19 and 26. Sufficient funds should be available for constructing the lock at each site.

## DAM NO. 8.

July 1, 1906, balance unexpended	\$203,397.65
Amount appropriated by river and harbor act approved March 2, 1907	251,845.00
	<u>455,242.65</u>
June 30, 1907, amount expended during fiscal year, for works of improvement	148,746.79
July 1, 1907, balance unexpended	306,495.86
July 1, 1907, outstanding liabilities	858.49
July 1, 1907, balance available	<u>305,637.37</u>
July 1, 1907, amount covered by uncompleted contracts	161,126.60
Amount (estimated) required for completion of existing project	<u>500,000.00</u>
{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907	
Submitted in compliance with requirements of sundry civil act of June 4, 1897.	250,000.00

## DAM NO. 11.

July 1, 1906, balance unexpended	\$326,750.58
Amount appropriated by river and harbor act approved March 2, 1907	198,343.00
	<u>525,093.58</u>
June 30, 1907, amount expended during fiscal year, for works of improvement	100,885.03
July 1, 1907, balance unexpended	424,208.55
July 1, 1907, outstanding liabilities	577.51
July 1, 1907, balance available	<u>423,631.04</u>
July 1, 1907, amount covered by uncompleted contracts	255,323.10
Amount (estimated) required for completion of existing project	<u>500,000.00</u>
{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907	
Submitted in compliance with requirements of sundry civil act of June 4, 1897.	200,000.00

## DAM NO. 13.

July 1, 1906, balance unexpended	\$324,843.08
Amount appropriated by river and harbor act approved March 2, 1907	174,778.00
Amount appropriated by sundry civil act approved March 4, 1907	100,000.00
Received from sale	48.62
	<u>599,669.70</u>
June 30, 1907, amount expended during fiscal year, for works of improvement	176,013.15
July 1, 1907, balance unexpended	423,656.55
July 1, 1907, outstanding liabilities	673.96
July 1, 1907, balance available	<u>422,982.59</u>
July 1, 1907, amount covered by uncompleted contracts	267,618.21
Amount (estimated) required for completion of existing project	<u>300,000.00</u>
{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907	
Submitted in compliance with requirements of sundry civil act of June 4, 1897.	<sup>a</sup> 185,000.00

<sup>a</sup> Of this amount \$55,000 is under contract authorization of 1899 and \$130,000 under that of 1907.

## DAM NO. 18.

July 1, 1906, balance unexpended.....	\$292,342.82
Amount appropriated by sundry civil act approved March 4, 1907.....	178,000.00
	<hr/>
June 30, 1907, amount expended during fiscal year, for works of improvement .....	470,342.82
	<hr/>
	103,672.84
July 1, 1907, balance unexpended.....	366,669.98
July 1, 1907, outstanding liabilities.....	1,232.15
	<hr/>
July 1, 1907, balance available.....	365,437.83
	<hr/>
July 1, 1907, amount covered by uncompleted contracts.....	166,580.46
Amount (estimated) required for completion of existing project..	100,000.00

## DAM NO. 19.

July 1, 1906, balance unexpended.....	\$107,988.36
Amount appropriated by river and harbor act approved March 2, 1907.....	200,000.00
	<hr/>
	307,988.36
Amount transferred to Lock and Dam No. 26 by act of March 2, 1907.....	100,000.00
	<hr/>
July 1, 1907, balance unexpended.....	207,988.36
July 1, 1907, outstanding liabilities.....	177.60
	<hr/>
July 1, 1907, balance available.....	207,810.76
	<hr/>
Amount (estimated) required for completion of existing project...	725,000.00

## DAM NO. 26.

July 1, 1906, balance unexpended.....	\$35,000.00
Amount appropriated by act of March 3, 1905, and repealed by act of March 2, 1907.....	35,000.00
	<hr/>
Amount appropriated by river and harbor act approved March 2, 1907.....	235,000.00
June 30, 1907, amount expended during fiscal year, for works of improvement.....	42.35
	<hr/>
July 1, 1907, balance unexpended.....	234,957.65
July 1, 1907, outstanding liabilities.....	238.95
	<hr/>
July 1, 1907, balance available.....	234,718.70
	<hr/>
Amount (estimated) required for completion of existing project..	965,000.00
	<hr/>
{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907.....	200,000.00
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

## CONSOLIDATED.

July 1, 1906, balance unexpended.....	\$1,290,322.49
Amount appropriated by river and harbor act approved March 2, 1907.....	1,059,966.00
Amount appropriated by sundry civil act approved March 4, 1907..	278,000.00
Received from sale.....	48.62
	<hr/>
	2,628,337.11

## CONSOLIDATED—continued.

Amount appropriated by act of March 3, 1905, and repealed by act of March 2, 1907-----	\$135,000.00
	<u>2,493,337.11</u>
June 30, 1907, amount expended during fiscal year, for works of improvement-----	529,360.16
	<u>1,963,976.95</u>
July 1, 1907, balance unexpended-----	3,758.66
July 1, 1907, outstanding liabilities-----	
	<u>1,960,218.29</u>
July 1, 1907, balance available-----	850,648.37
July 1, 1907, amount covered by uncompleted contracts-----	<u>3,090,000.00</u>
Amount (estimated) required for completion of existing project--	
{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907-----	
Submitted in compliance with requirements of sundry civil act of June 4, 1897.	
	835,000.00

(See Appendix G G 1.)

2. *Little Kanawha River, West Virginia.*—A description of the original condition of the river and its availability for purposes of commerce are given in the Annual Report of the Chief of Engineers for 1875, page 740.

The original project provided for removing rocks, snags, and overhanging and fallen trees above Burning Springs, W. Va., at a cost of \$7,300, as adopted by Congress on August 14, 1876. The act of Congress of June 14, 1880, made provision for the construction of a lock and dam about 2 miles above Burning Springs. This lock was opened to navigation on December 2, 1891, and has since been maintained under the indefinite appropriation for operating and care of canals and other works of navigation. Funds are appropriated from time to time for maintaining the present channel by the removal of obstructions which have re-formed.

Congress, in the act of March 3, 1905, provided \$75,000 for the purchase and \$88,000 for the repair of Locks and Dams Nos. 1-4, owned by the Little Kanawha Navigation Company, the project for which is contained in House Document No. 309, Fifty-eighth Congress, second session, as given in the Annual Report of the Chief of Engineers for 1904, page 2607.

Of the \$81,000 made available by act of March 2, 1907, \$79,500 is to be applied to the improvement of the structures purchased from the Little Kanawha Navigation Company, as set forth in detail on page 534 of the Annual Report of the Chief of Engineers for 1906; \$1,000 for maintenance of improvement above Burning Springs, and \$500 for making a preliminary survey for a lock and dam above Lock No. 5.

The amount expended to June 30, 1907, is \$337,165.13, of which \$1,843.90 was applied to maintenance, \$75,000 to acquisition, and \$46,838.89 to repair of Locks and Dams Nos. 1-4 (\$186.10 was received from sale of unserviceable property).

Slack-water navigation extends from Parkersburg to Creston, W. Va., a distance of 48 miles, and provides a depth of 4 feet. Owing to the poor condition of the structures purchased from the Little Kanawha Navigation Company, this depth has not been maintained during

the low-water season, as the repairs provided for have not been completed.

The maximum draft which can be carried at mean low water over the shoalest place in that section of the river under maintenance of improvement is 6 inches. Flatboat navigation extends to Burnsville, W. Va., about 120 miles above Parkersburg.

Work done under permits granted by the War Department for crossings, bridges, etc., was inspected. Additional funds having been made available for removing obstructions above Lock No. 5, preparations were begun for carrying on the work during the coming low-water season.

Extensive repairs were made to Lock and Dam No. 4, and both structures are in good condition. Preparations were made for repairing Locks and Dams Nos. 1 and 2 and building guide cribs at the locks. A survey was made and the land needed at each lock platted.

A statement of the commerce is contained in the report for operating and care of locks and dams on Little Kanawha River, West Virginia.

The freight rates by river were reduced in an amount equal to the tolls charged by the navigation company since the Government assumed control of Locks Nos. 1-4.

Reports on an examination of the river between Lock No. 5 and Burnsville and on the locks and dams not owned by the Government are contained in the Annual Report of the Chief of Engineers for 1904, pages 2597 to 2617.

#### ABOVE LOCK NO. 5.

July 1, 1906, balance unexpended.....	\$295. 51
Amount appropriated by river and harbor act approved March 2, 1907.....	1, 000. 00
	<hr/> 1, 295. 51
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	17. 65
July 1, 1907, balance unexpended.....	<hr/> 1, 277. 86

#### BELOW LOCK NO. 5.

July 1, 1906, balance unexpended.....	\$81, 298. 73
Amount appropriated by river and harbor act approved March 2, 1907.....	79, 500. 00
	<hr/> 160, 798. 73
June 30, 1907, amount expended during fiscal year, for works of improvement.....	40, 137. 62
July 1, 1907, balance unexpended.....	<hr/> 120, 661. 11
July 1, 1907, outstanding liabilities.....	3, 286. 62
July 1, 1907, balance available.....	<hr/> 117, 374. 49
July 1, 1907, amount covered by uncompleted contracts.....	<hr/> 15, 324. 18

#### SURVEY.

Amount appropriated by river and harbor act approved March 2, 1907.....	\$500. 00
July 1, 1907, balance unexpended.....	<hr/> 500. 00

#### CONSOLIDATED.

July 1, 1906, balance unexpended.....	\$81, 594. 24
Amount appropriated by river and harbor act approved March 2, 1907.....	81, 000. 00
	<hr/> 162, 594. 24



## CONSOLIDATED—continued.

June 30, 1907, amount expended during fiscal year:	
For works of improvement	\$40, 137. 62
For maintenance of improvement	17. 65
	<hr/> \$40, 155. 27
July 1, 1907, balance unexpended	122, 438. 97
July 1, 1907, outstanding liabilities	3, 286. 62
	<hr/>
July 1, 1907, balance available	119, 152. 35
	<hr/>
July 1, 1907, amount covered by uncompleted contracts	15, 324. 18
(See Appendix G G 2.)	

3. *Operating and care of locks and dams on Little Kanawha River, West Virginia.*—The lock and dam known as No. 5 was built under the appropriation for improving the Little Kanawha River, West Virginia, being a part of the original project as given in the Annual Report of the Chief of Engineers for 1875, page 740.

Locks and Dams Nos. 1-4 were purchased from the Little Kanawha Navigation Company and transferred to the Government on November 1, 1905.

The total amount expended in operating and care of these works to June 30, 1907, is \$50,855.53, of which \$7,950.67 was expended during the past fiscal year.

A table of the important features, giving location, year when finished, etc., of the locks and dams, is contained in the Annual Report of the Chief of Engineers for 1903, page 1720.

High water and ice interfered with navigation about forty-one days, although at No. 1 the lock was out of commission sixty days due to this lock being submerged. The raising of the walls, now provided for, will obviate this to a great extent.

The repairs to Locks Nos. 1-4 are provided for under improving Little Kanawha River, West Virginia. Gates and valves of lock and the two lower steps of dam at No. 5 were repaired. Locks and Dams Nos. 4 and 5 are in reasonably good condition; however, the dam and guide cribs of No. 5 will soon require rebuilding.

During the calendar year 1906 the commerce that passed Lock No. 5 amounted to 70,289 tons, of which 60,504 tons consisted of timber products (saw logs, ties, etc.). The decrease is no doubt due to the closing of navigation through Locks Nos. 4 and 5 during repairs at No. 4.

(See Appendix G G 3.)

4. *Kanawha River, West Virginia.*—A description of the condition of the river, the projects, and the general work accomplished (the locks and dams being in operation) are contained in the Annual Report of the Chief of Engineers for 1900, page 490.

The amount expended under the original project is \$50,000; that expended under the present project to June 30, 1907, is \$4,173,830.26 (\$2,257.32 was received from sales, etc.).

A project for the expenditure of the balance available from the funds appropriated June 4, 1897, provides for betterments to the existing works, constructing additional necessary buildings for shops, etc., procuring additional land, providing steam power for operating lock machinery, and dredging.

Work was continued under this project with the following results:

grading of Government land practically completed. Under contract with Cassady & Hanna about 40 per cent of the guide cribs has been finished at Lock No. 11. The machinery for operating lock gates, etc., with steam power at Lock No. 8 was completed and partly installed.

The maximum draft that can be carried at the shoalest part of the slack-water system at mean low water is 6 feet. Loup Creek shoal, about 90 miles above Point Pleasant, W. Va., is the head of navigation. The highest stage reached during the year was 33 feet at Charleston; the lowest, 1.4 feet at the falls.

For commercial statistics, see report for operating and care of locks and dams on Kanawha River, West Virginia.

The improvement of this river having been gradual, it is difficult to give the exact effect the improvement has had upon freight rates. There is no doubt, however, that the freight rates, where transportation by water is available, are regulated thereby. The rates for transportation by water have not changed materially, although the cost of floating plant has greatly increased.

A report of the examination of the unimproved section of the river, about 4½ miles between Lock No. 2 and the falls, is contained in the Annual Report of the Chief of Engineers for 1904, page 2587.

July 1, 1906, balance unexpended.....	\$58, 470. 12
June 30, 1907, amount expended during fiscal year, for works of improvement.....	8, 179. 92
July 1, 1907, balance unexpended.....	50, 290. 20
July 1, 1907, outstanding liabilities.....	240. 64
July 1, 1907, balance available.....	50, 049. 56
July 1, 1907, amount covered by uncompleted contracts.....	7, 308. 86

(See Appendix G G 4.)

5. *Operating and care of locks and dams on Kanawha River, West Virginia.*—Under the projects for improving the Kanawha River, ten locks and dams were built, two fixed dams and eight movable (Chanoine type), extending slack-water navigation for a distance of 90 miles from the Ohio River. The maintenance of these works is provided for by the indefinite appropriation for operating and care of canals and other works of navigation.

The location of each lock and dam and year in which completed are given in the Annual Report of the Chief of Engineers for 1899, page 428.

The total amount expended in operating and care of these works to June 30, 1907, is \$777,960.02, of which \$66,149.57 was expended during the past year.

A table of important features, giving available length and width of locks, length of pass, etc., is contained in the Annual Report of the Chief of Engineers for 1903, page 1724.

Navigation was practically continuous during the year. A stage of 33 feet was reached at Charleston on June 14. The movable dams were operated without accident.

The repairs required to keep the structures in good condition were made. These repairs are becoming more extensive each year, as part of the structures have been in service since 1880.

The commerce for the calendar year 1906 amounted to 1,327,703 tons, with a valuation of \$9,776,604. Of the foregoing there were

1,176,300 tons of coal and 75,234 tons of timber products, valued at \$1,176,300 and \$292,503, respectively.

(See Appendix G G 5.)

IMPROVEMENT OF MUSKINGUM RIVER, OHIO; OF BIG SANDY RIVER AND ITS FORKS, WEST VIRGINIA AND KENTUCKY, AND OF KENTUCKY RIVER, KENTUCKY.

This district was in the charge of Maj. J. G. Warren, Corps of Engineers, having under his immediate orders First Lieut. Paul S. Bond, Corps of Engineers, the entire year, and First Lieut. Arthur Williams, Corps of Engineers, since September 18, 1906. Division engineer, Col. G. J. Lydecker, Corps of Engineers.

*1. Muskingum River, Ohio.*—The original project, adopted August 11, 1888, provided for the construction of a lock at Dam No. 9, Tylorsville, Ohio, and the reconstruction of Lock No. 10, Zanesville, Ohio. The repair and extension of the levee above Dam No. 10, Zanesville, Ohio, was added by the act of July 1, 1898. Raising the crest of Dam No. 9 and building four lock houses was added by the act of June 13, 1902.

With the exception of the reconstruction of a lock at Zanesville—which was indefinitely postponed and the money originally appropriated for it diverted to other purposes—all of this work has been completed. Amount expended prior to operations under existing project, \$117,339.45.

The existing project, adopted March 3, 1905, provides for the raising of the crest of Dam No. 3 and building a lock-master's dwelling at Lock No. 10, at an estimated cost of \$8,000; and rebuilding Lock and Dam No. 11, \$110,000, provided that no part of this sum shall be expended unless the Secretary of War shall have satisfactory assurance that the State of Ohio or other agency will expend not less than \$200,000 upon that part of the Ohio canal system which connects the river above the lock with Lake Erie.

The appropriation of \$110,000 for rebuilding Lock and Dam No. 11 was based on an estimate made some ten years ago. To provide sufficient funds for the completion of this work at the present estimated cost, \$158,000, an additional appropriation of \$48,000 was made in the river and harbor act approved March 2, 1907.

Amount expended on the work under existing project up to the close of the fiscal year ending June 30, 1907, \$7,039.70.

Raising crest of Dam No. 3 has been completed.

Under date of March 28, 1907, an emergency contract was entered into with C. O. Waxler, of Philo, Ohio, for constructing a lock-master's dwelling and storehouse combined at Lock No. 10.

Under date of April 4, 1907, a contract was entered into with E. J. Landor, of Canton, Ohio, for constructing Lock and Dam No. 11, and accessories.

At the close of the year the work accomplished under these contracts consisted of assembling plant, materials, etc., and some progress made in the work of construction.

The miter-sill depth at pool level is the controlling mean low-water depth of the system; this is now 6 feet at all the locks, except the lower sill at Lock No. 1, at mouth of river, where it is about 3 feet at ordinary low water in the Ohio River.

The head of slack-water navigation is 84 miles above the mouth of the river. The usual variations in level of water surfaces is 38 feet at Lock No. 1 and 24 feet at Lock No. 10.

The commercial statistics are reported under the head of operating and care of locks and dams on Muskingum River.

It is believed that this improvement has had no material effect on freight rates.

July 1, 1906, balance unexpended.....	\$114, 801. 30
Received from various sources.....	19. 25
Amount appropriated by river and harbor act approved March 2, 1907 .....	48, 000. 00
	<hr/> 162, 820. 55
July 30, 1907, amount expended during fiscal year, for works of improvement .....	2, 641. 08
July 1, 1907, balance unexpended.....	160, 179. 47
July 1, 1907, outstanding liabilities.....	115. 60
July 1, 1907, balance available.....	<hr/> 160, 063. 87
July 1, 1907, amount covered by uncompleted contracts.....	140, 359. 00

(See Appendix H H 1.)

*2. Operating and care of locks and dams on Muskingum River, Ohio.*—Under allotments from the indefinite appropriation for operating and care of canals and other works of navigation there had been expended, up to June 30, 1906, a total sum of \$1,634,522.73, and an additional sum of \$17,190.44 in building a protection wall at Zanesville and altering certain bridges at Taylorsville and Marietta.

Amount expended during the year ending June 30, 1907, \$68,572.49.

The principal work has been dredging bars and channels; making repairs to locks, lock gates, operating machinery, dams, canal banks, lock houses, and floating plant; reconstructing, in concrete, conduit and lower guide and guard cribs at Lock No. 4; reconstructing, in concrete, the upper guard cribs at Lock No. 6; replacing with concrete piers the foundation of wood planer in workshop; and constructing concrete sidewalk in front of store yard at Lock No. 7; raising lower guide crib and constructing a 25-foot extension to same at Lock No. 8; reconstructing, in concrete, upper guard crib, revetment of canal embankment and lower slope and apron of dam, and rebuilding the upper and lower gates of the old lock at Lock No. 9; reconstructing, in concrete, revetment of canal embankment at Lock No. 10; rebuilding hull and cabin of dredge *Malta*; and the establishment of tentative harbor lines at Zanesville, Ohio. Under date of June 15, 1907, a contract was entered into with the Howard Ship Yards Company, of Jeffersonville, Ind., for a wooden-hull towboat at a cost of \$14,400.

Navigation was closed January 19 and March 13, 1907, and reopened January 25 and March 24, 1907, respectively.

The total commerce for the year 1906 was approximately 50,300 tons, valued at \$2,190,000; and 64,863 passengers.

(See Appendix H H 2.)

*3. Big Sandy River and Levisa and Tug forks, West Virginia and Kentucky.*—In their original condition this river and its forks were much obstructed by rocks, bars, snags, and leaning trees. During the low-water period of each year navigation was practically suspended.

The original project was adopted July 18, 1878, and provided for the removal of rocks, snags, and overhanging trees from the Big Sandy River and its forks. The construction of a lock and fixed dam below the junction of the two forks and near Louisa, Ky., was added by the act of June 14, 1880, and in 1891 was modified to admit of the construction of a movable instead of a fixed dam.

The work of clearing the forks of obstructions is carried on from year to year as funds are made available.

The amount expended on original and modified projects prior to operations under existing project, exclusive of maintenance on Levisa and Tug forks, was \$380,590.66.

The existing project, adopted March 3, 1899, contemplates carrying slack water from the Ohio River to Pikeville on Levisa Fork and to the mouth of Pond Creek on Tug Fork by the construction of 21 locks and dams, at an estimated cost of \$4,725,000. Of these locks and dams 10 are proposed for the Levisa Fork, 8 for Tug Fork, and 3 for the main river. The survey made for this improvement developed the fact that only 2 locks and dams would be required for the main river.

The raising of the crest of Dam No. 3, at Louisa, Ky., was added by the act of June 13, 1902, at an estimated cost of \$35,000.

The improvement at the mouth of the Big Sandy River by the construction of regulating works was added by the act of March 3, 1905, at a cost of \$40,000.

The construction of a steel service bridge at Lock No. 1, Big Sandy River, was added by the act of March 2, 1907, at a cost of \$7,000.

The amount expended on the work of the existing project up to the close of the fiscal year ending June 30, 1907, was as follows:

Big Sandy River, general improvement, including maintenance-----	\$762,132.64
Levisa Fork, maintenance-----	31,947.14
Tug Fork, maintenance-----	31,284.06

and at that date Lock and Dam No. 1, at Catlettsburg, and No. 2, at Kavanaugh, Ky., Big Sandy River, had been completed; the regulating works at its mouth under construction but little accomplished; the plans for a steel service bridge at Lock No. 1 and for raising crest of Dam No. 3 completed; Lock No. 1, Tug Fork, and Lock No. 1, Levisa Fork, completed, and the plans for the dams for these locks in a state of advancement.

With the exception of the service bridge at Lock No. 1, raising crest of Dam No. 3, and the regulating works at its mouth, which are provided for by specific appropriations to make the improvement available, the work is being carried on under the continuing-contract system, and the balance of the authorization remaining to be appropriated is \$135,000. This amount, in addition to the unexpended balance on June 30, 1907, can be profitably expended in the fiscal year ending June 30, 1909, in the extension of benefits by the construction of Dam No. 1, Tug Fork, and Dam No. 1, Levisa Fork.

Three locks on the Big Sandy River have been completed and opened to navigation. They provide a minimum depth of 6 feet on their lower miter sills, except at Lock No. 1, Catlettsburg, Ky., where the depth on the lower miter sill depends upon the stage in the Ohio River, and is uncertain and will remain so until a dam is placed in the Ohio River immediately below Catlettsburg.

The minimum draft that can be carried over the shoalest portions of the forks at mean low water is uncertain and changeable, and can

not be definitely stated owing to the constant movement of the bottom and the fact that the obstructions naturally renew themselves.

The commerce consists largely of timber, cross-ties, and staves, and varies somewhat with the condition of the streams, being greater during wet seasons and least during a long continued dry term. In general, it is about 125,000 tons for Tug Fork and 175,000 tons for Levisa Fork, a total of 300,000 tons per annum.

The Big Sandy River is navigable by steamer from Catlettsburg, the mouth of the river, up to Louisa, Ky., a distance of 27 miles, and from there to Chapman, Ky., on the Levisa Fork, and Saltpeter, W. Va., on Tug Fork, a distance of 9 and 4 miles, respectively. For pole boats, rafts, etc., the head of present navigation is taken at Pond Creek on Tug Fork and at Pikeville on Levisa Fork.

It is believed that the work thus far accomplished on this improvement has had no material effect on freight rates.

Experience with the works thus far completed and forming a part of the proposed navigation system for the Big Sandy River and its forks has shown the necessity for additional appliances to aid in the operation and maintenance of the works and of the channels connecting them.

An additional lock house is needed at Lock No. 2. Three lockmen and their families are crowded into two houses. The isolation of the site precludes the hire of quarters near the lock. Estimated cost, \$2,500.

A small dredging plant—towboat and combined pump and grapple dredge—is necessary for keeping the lock chambers and approaches and the connecting channels clear of deposit, drift, and sunken logs. Estimated cost, \$17,500. No estimate will be submitted for additional locks and dams, the matter being already before Congress in form for any action which may be deemed proper. It was stated in the final report of the survey of this river, upon which the project is based, that the value of the improvement could be foretold with certainty after the completion of four dams above Louisa on each of the forks. Until this improvement shall have reached this stage any estimate of its commercial value must be more or less conjectural.

A detailed statement of commercial statistics will be found in report for operating and care, etc.

July 1, 1906, balance unexpended.....	\$153,370.99
Received from various sources.....	.75
Amount appropriated by river and harbor act approved March 2, 1907.....	107,000.00
<b>June 30, 1907, amount expended during fiscal year:</b>	<b>260,371.74</b>
For works of improvement.....	\$49,150.39
For maintenance of improvement.....	3,470.22
	<b>52,620.61</b>
July 1, 1907, balance unexpended.....	207,751.13
July 1, 1907, outstanding liabilities.....	218.47
July 1, 1907, balance available.....	207,532.66
July 1, 1907, amount covered by uncompleted contracts.....	55,692.93
Amount (estimated) required for completion of existing project.....	3,840,000.00
<hr/>	
{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907.....	
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897.....	
	135,000.00

(See Appendix H H 3.)

4. *Operating and care of locks and dams on the Big Sandy River, West Virginia and Kentucky.*—Under allotment from the indefinite appropriation for operating and care of canals and other works of navigation there had been expended up to June 30, 1906, a total sum of \$38,508.12.

Amount expended during the year ending June 30, 1907, \$20,494.78.

The principal work has been clearing the channels and lock approaches of snags and other obstructions; making repairs to locks, lock gates, operating machinery, dams, lock houses, and floating plant; constructing workshop and tool house combined, repairing tripping-bar machinery for weir of dam, placing butterfly valves in upper lock gates, and constructing cribwork, etc., for protection of abutment below the dam at Lock No. 1; repairing and sodding slope back of land wall of lock, grading road through the Government reservation, repairing tripping-bar machinery of weir of dam at Lock No. 2; repairing hull and machinery of maneuvering boat, constructing workshop and tool house combined, and repairing dam at Lock No. 3.

Navigating was not closed during the year.

The total commerce for the year 1906 was approximately 281,971.36 tons, valued at \$2,450,548.10, and 577 passengers.

(See Appendix H H 4.)

5. *Kentucky River, Kentucky.*—At the time the United States assumed control of the Kentucky River the improvement that had been made by the State of Kentucky, which included five locks and fixed dams, was found to be in a dilapidated and almost worthless condition. Portions of Dams Nos. 1 and 2 on the lower part of the stream were gone entirely, so that navigation was suspended.

The original and existing project was adopted in 1879 (Annual Report of the Chief of Engineers for 1879, pp. 1398-1422) and provides for repairing and rebuilding the five old locks and dams, removing snags, logs, and other obstructions, and extending 6-foot slack-water navigation from the mouth of the river to the Three Forks, a distance of about 261 miles.

The amount expended to June 30, 1907, was \$2,903,309.92.

The result of this expenditure was the repair and the rebuilding of five old locks and dams constructed by the State; the construction of Locks and Dams Nos. 6, 7, 8, 9, 10, and 11; the purchase of site, preparation of plans and specifications and entering into contract for constructing Lock and Dam No. 12; survey of and negotiating for purchase of sites for Locks and Dams Nos. 13 and 14, and the construction of a dam at Beattyville.

This work is being carried on under the continuing-contract system, and the balance of the authorization remaining to be appropriated is \$519,000. This amount, together with the unexpended balance on June 30, 1907, can be profitably expended in the fiscal year ending June 30, 1909, in the extension of benefits by the construction of Locks and Dams Nos. 12 and 13.

The estimated cost of Lock and Dam No. 14 is \$415,650, not provided for in any existing legislation.

The greatest draft which can be carried at mean low water from Lock No. 1 to a point 2 miles above Irvine, Ky., a distance of 226 miles, which is at present the head of slack-water navigation, is 5.5 feet. Above this point no boats can run at a low stage.

The repairs to Locks 9 and 10, which were seriously damaged by the flood of March, 1905, have been completed, with the exception of the buildings at Lock No. 10, and the locks opened to navigation.

Ordinary low-water depth through Lock No. 1 and to the Ohio River, 4 miles below, is 6 feet or more, but at extreme low water only about 2½ feet can be carried over the lower sill of Lock No. 1. The usual variations of level of water surface are from 23 to 40 feet and occasionally much more.

The old locks, Nos. 1 to 5, inclusive, built by the State, have 145 feet available length and 38 feet width. The new locks, from No. 6 up, have available lengths of from 146 to 148 feet and are 52 feet in width.

The principal commerce on the river is timber, much of it loose logs, and the improvement is rather detrimental to this than otherwise. The logs are damaged in passing the dams and in their turn cause much damage to the works—are a prolific source of snags and of discouragement to any steamboat traffic that might develop.

Commercial statistics in detail are given in the report for operating and care of locks and dams on Kentucky River.

There are not likely to be any decided changes in the volume or character of the commerce benefited until the improvement is carried to the head of the river, where it is hoped that coal lands may be developed and the product shipped by water. The development of coal lands, with the resulting traffic, is the specific purpose to which the expenditure will be applied. It is believed that the project has had so far no material effect on freight rates.

July 1, 1906, balance unexpended.....	\$189, 228. 93
Amount appropriated by river and harbor act approved March 2, 1907.....	100, 000. 00
Amount appropriated by sundry civil act approved March 4, 1907.....	75, 000. 00
Amount received from other sources .....	42. 30

364, 271. 23

June 30, 1907, amount expended during fiscal year, for works of improvement.....	104, 387. 87
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July 1, 1907, balance unexpended.....	259, 883. 36
July 1, 1907, outstanding liabilities.....	619. 00

July 1, 1907, balance available.....	259, 264. 36
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July 1, 1907, amount covered by uncompleted contracts.....	389, 112. 75
Amount (estimated) required for completion of existing project.....	1, 710, 000. 00

Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907.....	a 519, 000. 00
Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

(See Appendix H H 5.)

6. *Operating and care of locks and dams on Kentucky River, Kentucky.*—Under allotments from the indefinite appropriation for operating and care of canals and other works of navigation there has been expended up to June 30, 1906, a total sum of \$1,338,956.67.

Amount expended during the year ending June 30, 1907, \$178,025.73.

The principal work has been dredging bars and channels; making

<sup>a</sup> Of this amount \$99,000 is under contract authorization of 1896 and \$420,000 under that of 1907.



repairs to locks, lock gates, operating machinery, dams, lock houses, and floating plant; repairing dam at Lock No. 3; reconstructing, in concrete, lower miter sill of Lock No. 4; repairs to dam, reconstructing, in concrete, upper miter sill of lock, and replacing upper wooden lock gates with new steel gates at Lock No. 5; rebuilding, in concrete, above sound timber the upstream end of land and river wall of Lock No. 6; rebuilding above pool level the lower gates of Lock No. 7; repairing washout around lock caused by flood of March, 1905, at Lock No. 9; repairing washout around lock caused by flood of March, 1905, and filling and riprapping behind crib below abutment at Lock No. 10. Under date of May 24, 1907, a contract was entered into for the construction of two new dump scows, at a total cost of \$6,216.

Navigation was closed on December 10, 1906, and reopened January 12, 1907.

The total commerce for the year 1906 was approximately 232,075 tons, valued at \$3,646,411.80, and 14,299 passengers.

(See Appendix H H 6.)

IMPROVEMENT OF FALLS OF THE OHIO RIVER, OF WHITE RIVER, INDIANA, OF WABASH RIVER, INDIANA AND ILLINOIS, AND OF CERTAIN RIVERS IN KENTUCKY.

This district was in the charge of Capt. Harry Burgess, Corps of Engineers. Division engineer, Col. G. J. Lydecker, Corps of Engineers.

*1. Falls of the Ohio River at Louisville, Ky.*—Improvements under this title have included the enlargement of the basin immediately above the locks of the Louisville and Portland Canal, the enlargement of the head of the canal, and straightening, deepening, and controlling the water flow in the Indiana chute channel.

The work of enlarging the basin above the canal locks was completed in 1893.

The original conditions at the other localities are more conveniently and fully described under separate headings, as follows:

*Head of Louisville and Portland Canal.*—Previous to 1883 the approach to the canal at its upper end, above the Louisville Bridge Company's bridge at Fourteenth street, was so narrow as to constitute a source of much expensive delay to the large quantity of traffic which came down the river on ordinary rises. The canal proper from Ninth to Fourteenth streets was only 100 feet wide and curved between the two points, so that progress was slow and accidents frequent and unavoidable. The greater part of the dike marking the north side of the approach to the canal was submerged when the river reached a stage of 8.4 feet, upper canal gauge, and at stages of 9 feet or more a strong current set out from the shore, thus carrying many vessels against the dike and, at high enough stages, over it onto the rock ledges. This approach was 1,800 feet long and varied in width from 400 feet at the upper end to 100 feet opposite Ninth street. Its area was wholly insufficient for the required breaking and rearrangement of tows preparatory to entering or leaving the canal.

*Indiana chute.*—This is the main channel of the river by which commerce passes over the falls when the stage of water is such as to permit navigation via that route. Originally it was very crooked, with swift currents and whirls, filled with dangerous rocky points projecting from the sides and bottom, and it could be navigated only

at stages of 11 feet or more, upper canal gauge. Even at such stages the services of special skilled pilots of long local experience and having intimate knowledge of the channel conditions were essential for reasonably safe passage through it.

*Projects.*—The original project for the enlargement of the head of the Louisville and Portland Canal was adopted in 1883 and proposed the enlargement of the canal, beginning at a point a short distance below the railroad bridge at Fourteenth street and extending eastwardly to the cross dam, so as to not only straighten and widen the canal proper, but also provide ample space for the necessary rearrangement of tows about to enter or leave the canal. This was slightly modified in 1885, so far as the location of the new north wall was concerned. A revision of the project was made by a Board of Engineer officers January 28, 1890, and approved by the Chief of Engineers January 31, 1890. This revision modified the area formerly proposed to be excavated and determined the number and kinds of structures, etc., to be erected. As approved, it provided for enlarging the canal on its northerly side from a point 725 feet below the railroad bridge at Fourteenth street, where the width of the canal was abruptly increased from 90 feet to 210 feet. This latter width is then gradually increased through a distance of nearly 2,800 feet to 325 feet at the head of the canal proper, at which point the enlargement is expanded into a capacious basin or harbor 1,200 feet wide and practically parallel to the Kentucky shore. The structures proposed were a new retaining wall on the north side of the canal, a movable dam about 800 feet long, a fixed dam extending from the movable dam at the westerly end of the basin to the south abutment of the movable dam in the Middle chute opening of the cross dam, the excavation of rock within designated limits to the same grade as the canal bottom, the construction of certain walls and slope revetment on the south side of the canal, and the removal of the old structures within the limits of the proposed enlargement. Under date of March 31, 1899, a further modification of some of the details of the project was considered by a Board of Engineer officers and their recommendations approved by the Chief of Engineers April 8, 1899. These later modifications, together with the work outlined in the report approved January 31, 1890, constitute the existing project toward the completion of which operations are now directed. The totals of estimates under the original project and the several revisions are as follows:

Project of 1883, page 1539, Annual Report of the Chief of Engineers for 1883	\$1, 335, 363. 00
Revision approved January 31, 1890, page 2217, Annual Report of the Chief of Engineers for 1890	710, 230. 40
Modification approved April 8, 1899, page 2545, Annual Report of the Chief of Engineers for 1899	300, 391. 92
A revision of the latter estimate was made November 13, 1900, approved by the Chief of Engineers November 17, 1900, and amounted to	398, 359. 12

The foregoing relates particularly to the improvements at the head of the Louisville and Portland Canal.

Prior to January 31, 1890, there was no specific comprehensive project for the systematic improvement of the Indiana chute channel although much work, consisting of the removal of some of the more dangerous rock ledges, had been done under estimates and allotments from appropriations for improving Ohio River. On the date just mentioned the project submitted by a Board of Engineer officers for

the radical improvement of this chute was approved by the Chief of Engineers. This project had for its object the widening and deepening of the channel by rock excavation to specified grades within certain limits and the control of water flow in the channel by means of dikes, etc., so as to make this channel available for descending navigation drawing  $6\frac{1}{2}$  feet at stages of 8 feet, upper canal gauge. However, only a part of the work necessary for the purpose in view was included in the estimate accompanying the report of the Board, it being stated:

As the exact knowledge of the results of that work [i. e., the work estimated for in the Board's report] would be of great importance in fixing the details of location and cross section of the additional works that will be required, it would be as well to leave the determination of the additional work above the bridge to a later day.

The estimates for work on this chute since the adoption of a specific project therefor are as follows:

Project approved January 31, 1890.....	\$138, 610. 97
Modification approved April 8, 1899.....	74, 320. 98
Revision of estimate approved by the Chief of Engineers November 17, 1900.....	129, 651. 99

A consolidation of the projects for the enlargement at the head of the canal and the improvement of the Indiana chute was authorized by the Chief of Engineers June 28, 1897, and since that date funds have been provided for work at both localities under one title of appropriation.

Work under that part of the project relating to the Indiana chute having been completed, a Board of Engineer officers was assembled to determine, as anticipated in the project of 1890, what further work was essential to provide the requisite depth necessary to facilitate the passage of traffic through this channel. The report of the Board was submitted December 16, 1901, and approved by the Chief of Engineers December 30, 1901. The items of additional work found to be necessary to produce the desired result and the estimated cost thereof are as follows:

Submerged dam at Whirlpool Point (large stone), 2,500 cubic yards, at \$3.....	\$7, 500
Raising movable dam north of canal wall.....	2, 500
Removing old dam and building movable dam, 1,000 feet, at \$75.....	75, 000
Longitudinal contracting dikes (concrete), 22,300 cubic yards, at \$12.....	267, 600
Submerged dams below bridge (concrete), 3,000 cubic yards, at \$20.....	60, 000
Rock excavation, 3,200 cubic yards, at \$3.50.....	11, 200
Contingencies, 10 per cent.....	42, 380
Total.....	466, 180

For this latter work the Board prescribed the order in which it should be done, and stated that it was possible that a part of the work might become unnecessary if certain results were produced by the submerged dam at Whirlpool Point, and in that event about \$125,000 would probably be saved from the estimated cost.

The estimate for this additional work on the Indiana chute does not affect the former estimate for work to be done at the head of the canal, except in so far as it provides \$2,500 for increasing the height of the movable dam north of canal wall. This item has been revised and the reconstruction of that section of dam with a crest elevation of +12.7 feet, upper canal gauge (415.704 feet above sea level), provided for from the appropriation of \$271,000 made by act of March 2, 1907, and \$240,000 of the said appropriation will be used for the

construction of 500 feet of Boulé dam in Middle chute, 648 feet of Chanoine dam in Indiana chute, and about 600 linear feet of concrete dam between Indiana chute and the north bank of the river. These sections of dam constitute additions to the former projects and are to have their crests at elevation +9 feet, upper canal gauge (412.004 feet above sea level). This height is such as will afford a minimum depth of 9 feet upstream to Madison, Ind., and a minimum depth of 6 feet on the lower miter sill at Lock No. 1, Kentucky River.

Following is a brief synopsis of expenditures under the allotments and projects summarized above:

Expended from allotments, 1881, to January 31, 1890-----	\$116, 049. 80
Expended under project of 1883, for enlargement of head of canal, to January 31, 1890-----	347, 380. 68
Reserved, Office Chief of Engineers, United States Army-----	1, 874. 20
Expended under project for enlarging canal basin at locks-----	133, 000. 00
Expended under revised project of January 31, 1890, to June 30, 1897:	
On enlargement at head of canal-----	\$298, 856. 35
On Indiana chute channel-----	103, 602. 81
	402, 459. 16
Expended under appropriations for enlargement at head of canal and Indiana chute, in accordance with project of January 31, 1890, to March 31, 1899-----	208, 659. 75
Expended under appropriations for enlargement at head of canal and Indiana chute, in accordance with the modified project of March 31, 1899 (approved April 8, 1899), to June 30, 1907, not including outstanding liabilities-----	424, 592. 18
Total-----	1, 634, 015. 77

The results derived from the expenditures to date for those portions of the work completed have been of marked advantage to traffic and greatly facilitate its movement. The enlargement of the basin immediately above the new locks was completed in 1893 and increased the width of the canal at that locality from 90 feet to 215 feet throughout a distance of 800 feet. At the head of the canal the work of enlargement has been entirely completed from a point 725 feet below the Fourteenth Street Railroad Bridge to a point 2,800 feet above that bridge. Beyond this point, in the basin east of the north canal wall, the excavation to grade within the prescribed limits is about 97 per cent completed, a clear width of 415 feet excavated to grade being at this date available.

In the Indiana chute above Fourteenth Street Bridge the channel width has been increased from 200 feet to 400 feet, and all rock within these limits excavated to the grades prescribed in the project. At Wave rock and Willow Point all excavation and the dikes have been completed. The depth of water over Wave rock and Willow Point approximates very closely the depth anticipated—i. e., 8 feet, when there are 8 feet on the upper canal gauge. But the depth on the upper portion of the chute is still unsatisfactory; hence the necessity for the additional work recommended in the Board's report of December 16, 1901, and approved by the Chief of Engineers December 30, 1901. The additional work includes structures designed so as to produce the desired depth of 8 feet by forcing a sufficient volume of water into that part of the chute above the Fourteenth Street Bridge and controlling its flow therein. The chute can now be navigated with ease by heavy-draft coal boats at stages of 11.5 or more, upper canal gauge, but as coal barges reach Louisville on an 8-foot stage and coal boats on a 9½-foot stage, the necessity becomes apparent for pro-

viding sufficient depth in the open-river channel in order to facilitate the passage of commerce without the heavy, unavoidable incidental expense due to breaking, rearranging, and passage of tows through the canal locks, and, not infrequently, the loss of opportunity to continue without interruption the journey on the stage of water prevailing on arrival of the tow at this place, the stage in many instances being of such short duration as to pass before the tows can be passed through the canal, reassembled, and regain the crest of the wave.

The following statement shows the remaining items of approved projects for which no appropriations have been made:

2,500 cubic yards, submerged dam at Whirlpool Point.....	\$7, 500. 00
22,300 cubic yards, longitudinal contracting dikes.....	267, 600. 00
3,000 cubic yards, submerged dams below railroad bridge.....	60, 000. 00
3,200 cubic yards, rock excavation, Indiana chute.....	11, 200. 00
Contingencies.....	34, 630. 00
Total.....	380, 930. 00

In the statement of last year's report the "amount (estimated) required for completion of existing project" was given as \$472,215.99, made up as follows:

Balance of estimate approved November 17, 1900.....	\$81, 035. 99
Balance of cost of work recommended in Board's report of December 16, 1901, approved December 30, 1901.....	391, 180. 00
Total.....	472, 215. 99
The act of March 2, 1907, added new work, not included in either of the above items, amounting to.....	271, 000. 00

Thus making a total of..... 743, 215. 99  
From which there must be deducted amounts appropriated by the act of March 2, 1907, as follows:

For raising the dam.....	\$271, 000
For removal of rock.....	43, 000
	314, 000. 00

Leaving a balance of..... 429, 215. 99

as the "amount (estimated) required for completion of existing project" at the close of the past fiscal year, which amount is more than ample for the remaining items of work under existing projects. But the Ohio River Board has recommended that these remaining items of work be not done, as the work recommended by that Board will render such items of work unnecessary. Therefore, it is not deemed advisable to make any modification of present estimates for completion of project until Congress has indicated which of the plans is to be pursued.

July 1, 1906, balance unexpended.....	<sup>a</sup> \$64, 959. 42
October 17, 1906, from transfer of property.....	350. 00
Amount appropriated by river and harbor act approved March 2, 1907.....	314, 000. 00

June 30, 1907, amount expended during fiscal year, for works of improvement.....	379, 309. 42
	30, 826. 33

July 1, 1907, balance unexpended.....	348, 483. 09
July 1, 1907, outstanding liabilities.....	3, 469. 87
July 1, 1907, balance available.....	345, 013. 22

July 1, 1907, amount covered by uncompleted contracts.....	53, 850. 47
Amount (estimated) required for completion of existing project.....	429, 215. 99

(See Appendix I I 1.)

2. *Operating and care of Louisville and Portland Canal.*—This canal was constructed by a private corporation, acting under a charter granted by the Kentucky legislature in 1825 and subsequent acts of the same body extending the time for completion and increasing the capital stock. It was completed and the first boat passed through it December 22, 1830. At that time there were three combined lift locks, each with a lift of about  $8\frac{3}{4}$  feet, a width of 50 feet, and length of 200 feet. The width of the canal proper was from 64 to 68 feet at normal stages, with a depth of nearly 3 feet at extreme low stages of the river. There was no dam at the head of the canal. The United States became a stockholder in the corporation in 1826, and gradually increased its holdings until all of the outstanding stock and bonds passed into its possession.

In 1860 an enlargement and extension of the canal which included new locks was begun under the corporate management, and resulted in the width of the canal being increased to 90 feet, with three basins, or passing places, and the construction of two new combined lift locks with a total lift of about 26 feet. Each of the chambers of the new locks has a width of 80 feet and an available length of 350 feet. The new locks were opened to navigation February 6, 1872.

The United States assumed charge of the work of enlargement of the canal and construction of a dam at the head of the canal subsequent to the allotment of funds for that purpose in 1868, but the operation of the canal and collection of tolls remained under control of the corporate management until June 11, 1874, upon which date the entire control of the canal was assumed by the United States, pursuant to the act of Congress of May 11, 1874, which provided that the canal should be held "free of all tolls and charges, except such as are necessary to pay the current expenses of said canal and keep the same in repair." Tolls were entirely abolished after midnight, July 1, 1880, and since that date the expenses of operation and maintenance of the canal have been borne directly by Treasury funds made available by the act of March 3, 1881, and the indefinite appropriation for "Operating and care of canals and other works of navigation," act of July 5, 1884.

The general project for operation and care of the canal by expenditures under allotments from the act of July 5, 1884, contemplates the operation of the canal locks, the operation of the dredging plant to keep the canal clear of deposit brought into it by high water, and the repair of existing structures, so as to maintain the whole system in good serviceable condition. The funds are provided under estimates submitted annually at the beginning of each fiscal year and allotments therefor from the act of July 5, 1884.

The approved project, estimate, and allotment for the fiscal year 1907, in addition to the provisions for ordinary current repairs, supplies, miscellaneous work of maintenance, operation of locks and dredging plant, included items for completing new combined dredge and derrick boat, new machinery for dredge *Wabash*, and completion of south canal wall. The estimate for the year amounted to \$129,983.46, and was made available July 13, 1906.

In reporting the total of expenditures made in connection with this work it seems best, for the purpose of clearness in showing the general

application, to subdivide the total to date into amounts for each period indicated, as follows:

From allotments and appropriations, September, 1868, to June 30, 1882, for completion of new locks, enlargement of canal, and for cross dam at head of canal, payment of bonds, etc.	\$1, 463, 200. 00
From tolls collected by United States, June 11, 1874, to midnight July 1, 1880, for operation and maintenance	417, 069. 38
From allotments from act of March 3, 1881, for operation and maintenance	214, 062. 91
From allotments from act of July 5, 1884, for operation and maintenance	1, 940, 254. 73
Total	4, 034, 587. 02

The canal is available to commerce at all stages of the river less than 12.7 feet, upper canal gauge, and affords free navigation around the falls of the Ohio River at stages of water when the passage there-over can not be made by the open-river channel.

The zero of the upper gauge corresponds to reference 35 and the bottom of the canal at its head to reference 34, canal datum. The lowest recorded reading of the upper gauge is 1.7 feet; the highest reading on the same gauge is 46.7 feet.

Under the regulations prescribed by the Secretary of War for the use, administration, and navigation of this canal the maximum draft of vessels that can be passed through the canal is limited to the depth of water above zero of the gauge at the time the boat enters the canal.

References to more extended information concerning original condition, purchase, and progress of the improvement of this canal are given on page 491, Annual Report of the Chief of Engineers for 1904.

For a comparative statement of commerce, see the report on this work by district officer.

During the fiscal year ending June 30, 1907, 5,342 boats, barges, and small craft passed through the canal, carrying 1,079,534½ tons freight. During the same period 1,545 boats, barges, and small craft passed over the falls via the open-river channel, carrying 453,792 tons of freight, thus making the aggregate that passed Louisville via both routes 6,887 boats, barges, and small craft, and 1,533,326½ tons of freight.

(See Appendix I I 2.)

3. *Wabash River, Indiana and Illinois.*—At the time the United States began the work of improving this river it was badly obstructed by bars, accumulations of snags, rocky reefs, and numerous secondary channels or cut-offs, which lessened the flow of water through the main channel. Navigation was impracticable except at high stages of water. A lock and dam has been built at Grand Rapids by the Wabash Navigation Company and a few improvements made at other places, also by private enterprise, but as none of them was of a substantial character they rapidly deteriorated and became useless.

The original project and outline of improvements proposed is found in the report of Maj. G. Weitzel, Corps of Engineers, January 4, 1872, page 472, Annual Report of the Chief of Engineers for 1872. The first appropriation for work under this project was made by Congress June 10, 1872. This project proposed the improvement of the river from its mouth to Lafayette, Ind., by special works at 12 designated localities, the construction of a new lock and dam at Grand



Rapids, and the general work of snagging and dredging. The estimated cost of the work proposed amounted to \$312,672.62. Work at various places other than those mentioned in the project has been added from time to time, but no general revision of the original estimate has been made.

The river and harbor act of March 3, 1881, made separate appropriations for work above Vincennes and for work below Vincennes, thus dividing the original project, and subsequent to that date funds have been provided separately for each section.

From the commencement of the work, in 1872, to March 31, 1881, the expenditures, all of which were for work below Vincennes, amounted to \$324,845.44. Those for work since that date are given under their respective headings, as follows:

(a) *Below Vincennes.*—Subsequent to 1881 work was continued under the original project, but the estimates were modified from time to time as necessity therefor arose, as in the cases of the dam for closing the New Harmony Cut-off, the lock and dam at Grand Rapids, etc. Levee work at Grayville, Ill., was added in 1887, and completed, as proposed, at a cost of \$25,000. In 1898 a plan and estimate, amounting to \$50,000, for additional work at New Harmony was approved, but at the same time it was urged that if the improvement of the river was to be continued the old project should be abrogated, a comprehensive survey of the river made, and a new project formulated, based upon data furnished by the survey and of sufficient scope to meet existing needs of commerce. The survey was authorized and funds therefor provided by the river and harbor act of June 13, 1902. The report on the survey, proposed plan for improvement, estimate of cost, and action taken in connection therewith may be found on page 2729, Annual Report of the Chief of Engineers for 1904. The aggregate of the items of the original estimate applicable to this part of the river and of the several subsequent estimates constituting the estimate of cost of existing project adopted by Congress is \$755,000.

The expenditures to March 31, 1881, amounted to \$317,845.44, in addition to the \$7,000 paid to extinguish the franchise of the Wabash Navigation Company and acquire their property, those for the levee work at Grayville from 1887 to 1892, \$25,000, and those for other work since 1881 on this part of the river, \$365,111.76, or an aggregate of \$714,957.20 for work below Vincennes to June 30, 1907.

Previous to 1885 a fairly good channel for boats having a draft not exceeding 2½ to 3 feet was maintained, but as the river and harbor act of July 5, 1884, made specific appropriation for a lock and dam at Grand Rapids, near Mount Carmel, Ill., the suspension of operations elsewhere became necessary, in view of the fact that the funds available since that date were not sufficient to complete the lock and dam, and at the same time maintain the former works for bank protection, and to concentrate the water flow and clear the channel of obstructions. Consequently the work formerly done deteriorated rapidly, the structures being destroyed by ice and high water or rendered useless by the water cutting its way around them. The channels, cut through rock reefs and shoal places, became choked with snags, stumps, and bowlders, thus leaving the river without any permanent improvement excepting that resulting from the lock and dam at Grand Rapids. Through navigation at low water is impracticable.



Boats drawing 20 inches can pass from Mount Carmel to Vincennes (a river distance of about 34 miles) at all stages, but can reach Mount Carmel, 92.7 miles from the mouth of the river, only when the gauge at the lock reads 7.5 feet or more.

Commercial statistics will be found in the report for operating and care of lock and dam at Grand Rapids, Wabash River (Appendix I I 4).

References to more extended information are given on page 494, Annual Report of the Chief of Engineers, 1904.

The work remaining to be done under the projects and estimates so far approved is that of closing the cut-off at New Harmony, Ind. The estimated cost of this work has been \$50,000, but is now, for reasons stated in the report of the district officer, increased to \$75,000. (See Annual Report of the Chief of Engineers for 1898, p. 1979.)

It is not believed that the improvement has had any influence upon freight rates.

July 1, 1906, balance unexpended.....	\$42. 80
July 1, 1907, balance unexpended.....	42. 80
July 1, 1907, outstanding liabilities.....	25. 75
July 1, 1907, balance available.....	17. 05
Amount (estimated) required for completion of existing project.....	75, 000. 00

(b) *Above Vincennes.*—At the time this section of the river became the object of separate appropriations there had been no revision of the estimate in the original project for the improvement of the river from its mouth to Lafayette. Under the project matured after the appropriation had been made (see Annual Report of the Chief of Engineers for 1881, p. 2001), and subsequent modifications, the estimates to June 30, 1907, amounted to \$95,500.

The expenditures on the work of existing project to June 30, 1907, amounted to \$95,254.87.

The funds available during the past sixteen years have not been sufficient to maintain the former works for channel rectification and to keep the river clear of snags, bars, and similar obstructions. During the more recent years not enough funds have been available for snagging purposes alone. Therefore it can not be said that any permanent improvement of this section of the river has been effected or that navigation is practicable, except at high stages of water.

The only commercial statistics available are those collected at the lock at Grand Rapids. (See Appendix I I 4.) References to more extended information may be found in the Annual Report of the Chief of Engineers for 1904, page 495.

It is not believed that the improvement has had any effect on freight rates.

July 1, 1906, balance unexpended.....	\$261. 58
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	16. 45
July 1, 1907, balance unexpended.....	245. 13

(See Appendix I I 3.)

4. *Operating and care of lock and dam at Grand Rapids, Wabash River.*—This lock and dam was built from funds derived from appro-

priations for improving Wabash River, Indiana and Illinois, and opened to navigation in November, 1893. The available length of the lock is 214 feet; width, 52 feet; depth on lower miter sill at low water, 3.5 feet; depth on upper miter sill at normal pool stage, 5.08 feet. At such stage the pool above the lock affords slack-water navigation about 12 miles, and the maximum draft that can be carried is about 2 feet. Conditions beyond the pool are mentioned in the report for improving Wabash River, Indiana and Illinois.

The expenses of operating the lock were paid from the appropriations for improvement of the river until March 1, 1897, since which date they have been paid from annual allotments from the indefinite appropriation for "Operating and care of canals and other works of navigation," act of July 5, 1884.

The first and subsequent annual projects proposed the operation of the lock and the maintenance of it and the appurtenant structures in good serviceable condition. The expenditures under these projects to June 30, 1907, amounted to \$31,310.40.

The project for the fiscal year 1907 provided for the operation of the lock, completion of crib below abutment of dam, repairs to dam, fences, etc., at an estimated cost of \$3,500, which amount was made available by allotment July 16, 1906. The amount expended during the fiscal year ending June 30, 1907, not including outstanding liabilities, is \$2,621.11.

During the past fiscal year 1,886 boats, barges, etc., and 6,600½ tons of freight passed the lock.

A comparative statement of traffic and commerce passing this lock during the past ten years will be found in the report on this work by the district officer.

(See Appendix I I 4.)

5. *White River, Indiana.*—Originally this tributary to Wabash River was badly obstructed by rocky reefs, remains of old structures, and a very great number of snags. It could be navigated only at high stages of water.

The original project is based upon the report of "examination of White River and its forks in Indiana," submitted December 31, 1878. The first appropriation for the improvement was made in the act of March 3, 1879. In this act the work of improvement was limited to "White River, Indiana, from Wabash River to Portersville, and to the falls on the West Fork, according to Report of the Chief of Engineers, without constructing locks and dams." A minimum depth of 2 feet at low water was sought. In 1886 the estimate was reduced. The river and harbor act of August 18, 1894, provided for a resurvey of the river.

Subject to the modifications mentioned, the original project constitutes the existing project of this date. The estimate of cost is \$120,000. The amount expended to June 30, 1907, not including outstanding liabilities, is \$119,296.18. As a result of these expenditures the lower 13 miles of the river is navigable all the year for boats having a draft not exceeding 3 feet. Above this, to the junction of the two forks, boats drawing 18 inches can navigate for about six months of the year. Low-water navigation on the forks is impracticable even for the smallest boats. This information is derived from the report on the resurvey made in 1895-96, since

which date operations have been suspended, the funds available not being sufficient for either work of improvement or maintenance of former structures for controlling the flow of water and bank protection or to keep the channel clear of snags.

No statistics as to the volume or character of commerce moved on this river during the past year are available.

The report upon the resurvey of the river (Annual Report of the Chief of Engineers for 1897, p. 2483) contains data concerning the volume and character of commerce that would be benefited by or involved in the further improvement of the river. This report also contains estimates of cost of improvement under alternative plans and a recommendation that "the further improvement of the White River should be postponed until the improvement of the Wabash has been such as to afford an outlet for any traffic which may then be developed on White River."

References to more extended information concerning this river may be found in Annual Report of the Chief of Engineers for 1904, page 497.

July 1, 1906, balance unexpended	\$703.82
July 1, 1907, balance unexpended	703.82

(See Appendix I I 5.)

6. *Green River, above the mouth of Big Barren River, Kentucky.*—Originally this part of Green River was much obstructed by snags, large boulders, and overhanging trees. Dam No. 4, Green River, afforded slack water for about 18 miles above the confluence of Green and Barren rivers. The fall in that part of the river above slack water and below Mammoth Cave, Ky., a distance of about 29 miles, was approximately 27 feet.

The original project is that submitted under date of August 11, 1891 (printed in Annual Report of the Chief of Engineers for 1891, p. 2481). It proposes the extension of slack-water navigation from the upper limits of pool No. 4 to Mammoth Cave by the construction of two locks and dams at an estimated cost of \$361,346.40 for both. No revision of the project and estimate has been made except as provided by the river and harbor act of March 3, 1905, for work of snagging and clearing banks of Nolin River, which will be affected by slack water from Dam No. 6, Green River, for which \$5,000 has been appropriated.

The amount expended to June 30, 1907, exclusive of outstanding liabilities on that date, is \$365,093.03.

As a result of these expenditures Locks and Dams Nos. 5 and 6 have been completed and opened to navigation, thus extending slack water to Mammoth Cave, Ky., and through a part of the rich mineral district bordering the river which previously had no conveniently accessible transportation route.

Commercial statistics are given in the report for operating and care of locks and dams on Green and Barren rivers, Kentucky (Appendix I I 7).

References to more extended information may be found in Annual Report of the Chief of Engineers for 1904, page 498.

Report of examination of the river from Lock No. 6 to Munfordville may be found in House Document No. 377, Fifty-ninth Congress, first session.

Sufficient data are not available upon which to determine the effect of the improvement on freight rates, if any.

July 1, 1906, balance unexpended.....	\$9,037. 74
June 30, 1907, amount expended during fiscal year, for works of improvement.....	8,457. 57
July 1, 1907, balance unexpended.....	580. 17
July 1, 1907, outstanding liabilities.....	94. 74
July 1, 1907, balance available.....	485. 43

(See Appendix I I 6.)

7. *Operating and care of locks and dams on Green and Barren rivers, Kentucky.*—The original system of slack-water navigation on these rivers, including 4 locks in Green River and 1 lock in Barren River, with a total length of pools of approximately 200 miles, was completed by the State of Kentucky in 1841. The State retained control and management of the system until 1868, when it was leased to the Green and Barren River Navigation Company for a term of thirty years. The act of the Kentucky legislature, approved February 20, 1886, ceded the entire system to the United States upon condition that the unexpired portion of the lease to the Navigation Company be purchased by the United States. The river and harbor act of August 11, 1888, appropriated \$135,000 "for the purchase of the improvements known as the Green and Barren River improvements." The deed from the Green and Barren River Navigation Company relinquishing all their rights, privileges, etc., having been duly approved by the Attorney-General of the United States, and the purchase money paid to said company, the Government assumed control of the river, the improvements therein, and the property formerly owned by the State, December 11, 1888.

The condition of the improvements and of the rivers at that date was as follows: Lock and Dam No. 1, Green River, required many repairs. The walls of Lock No. 2 were cracked and in bad condition generally, the land wall especially so, it being held in position by anchorage to cribs filled with stone; the river wall had yielded outward. Lock No. 3, Green River, was broken entirely, the river wall having yielded outward and fallen into the river. Lock and Dam No. 4, Green River, was in fairly good condition, with the exception of needed repairs to the quoins and gates. The walls of Lock No. 1, Barren River, were so badly cracked that a part of one of them, the land wall, leaned toward the lock chamber about 6 inches and was liable to fall at any time. The entrances to the locks were obstructed with deposit and the pools with great numbers of snags, overhanging trees, etc.; the appurtenant structures at the locks and the lock-tenders' dwellings were in bad condition and inadequate. No snagging or dredging plant was available.

Excepting the funds for rebuilding Lock No. 2, Green River, which were provided by specific appropriations, the funds for the restoration of former structures, the operation of the locks, and maintenance of the system in good navigable condition have been provided by allotments from the indefinite appropriation for "Operating and care of canals and other works of navigation," act of July 5, 1884, under estimates submitted annually at the beginning of each fiscal year. The first project for work on these rivers under the latter act was

approved January 4, 1889, and proposed the restoration, so far as practicable, of the former structures to good serviceable condition, the construction of new ones where required, the operation of the locks, the removal of snags, landslides, and deposit from the entrances to the locks, etc., and such has been the general object of each subsequent annual estimate and project.

In addition to the items for the usual work of operation and maintenance, the project and estimate for the fiscal year 1907 provided for completing the construction of upper and lower shore cribs of concrete at Lock No. 2, Green River; reconstruction with concrete of abutment and upper and lower shore cribs at Lock No. 4, Green River; construction with concrete of lower river crib at Lock No. 1, Barren River, and various repairs of less important nature to the other structures and floating plant. The estimate for the fiscal year amounted to \$79,990.58, which was made available by allotment July 16, 1906.

Expenditures during the fiscal year, not including outstanding liabilities June 30, 1907, amounted to \$79,228.02.

The aggregate expenditures under the project of January 4, 1889, and subsequent annual projects to June 30, 1907, is \$1,273,316.61.

The result of these expenditures is the thorough repair of the several locks of the former system and their appurtenant structures, and the restoration of through navigation in the pools from Lock No. 1, Green River, to Bowling Green, Ky., on Barren River, a distance of 172 miles, for boats not exceeding 35 feet in width, 138 feet in length, and draft not exceeding 5 feet.

At extreme low water in the open river below Lock No. 1, Green River, there is a depth of only 1 foot on the lower miter sill of that lock, which is located 8 miles above the mouth of the river. The system now includes 7 locks and dams, Locks Nos. 5 and 6, Green River, having been built from funds provided by specific appropriations.

Following is a synopsis of traffic and commerce through the locks during the fiscal year 1907:

	Boats.	Freight.
GREEN RIVER.		
Lock No. 1.....	4,907	<i>Tons.</i> 372,915
Lock No. 2.....	2,733	271,762
Lock No. 3.....	2,456	205,497
Lock No. 4.....	2,438	135,320
Lock No. 5.....	1,436	95,099
Lock No. 6.....	1,300	58,621
BARREN RIVER.		
Lock No. 1.....	1,530	43,993

A comparative statement of the traffic and commerce on these rivers will be found in the report on this work by the district officer.

References to more extended information may be found in Annual Report of the Chief of Engineers for 1904, page 500.

(See Appendix I I 7.)

8. *Rough River, Kentucky.*—Originally this river was much obstructed by snags, sunken logs, stumps, bowlders, and bars in the bed of the stream, and by overhanging trees on its banks. Backwater from Dam No. 2, Green River, affected 8 miles of the river above its

confluence with Green River. The width of the river varied from about 100 to 200 feet, and the movement of commerce was limited to periods of high water. A timber-crib lock and dam had been built on the river about 7 miles above Livermore, Ky., by the Rough Creek Navigation and Manufacturing Company, but at the time the United States undertook the improvement of the river the structures had been abandoned and were completely in ruins, and all rights, powers, and privileges granted said company by the State legislature annulled.

The original project is found in the report of Maj. James C. Post, Corps of Engineers, dated January 27, 1885, page 1894, Annual Report of the Chief of Engineers for 1885, and was adopted by Congress in the river and harbor act of September 19, 1890, and has for its object the extension of slack-water navigation to Hartford, Ky., by the construction of a lock and dam and clearing the stream of snags, overhanging trees, and other obstructions. A revision of the project, so far as it relates to the estimate, dimensions of lock and dam, and the number and kind of other structures necessary in connection with the lock, was made August 31, 1891. A further modification in 1895 substituted concrete for stone in the construction of the lock and provided for minor changes in the dimensions previously proposed.

The existing project is the same as that outlined in the preceding paragraph, the revised estimate of August 31, 1891, amounting to \$105,556.05. Expenditures on the work of existing project up to the close of the fiscal year ending June 30, 1907, not including outstanding liabilities, amounted to \$105,393.21.

The lock, dam, and appurtenant structures have been completed. The lock was opened to navigation December 12, 1896. The maximum depth that can be carried at the upper end of the pool above the lock at normal pool stage is about 4 feet; the depth on the upper miter sill at such stage is 6.8 feet. The available length of the lock is 123 feet and available width 27 feet. At low water the head of navigation is a short distance above Hartford, Ky., or about 29½ miles above the mouth of the river and 21½ miles above the lock. Beyond this navigation is practicable only at high stages of the river, and consists principally of rafts and rowboats.

Commercial statistics are given in the report for operating and care of lock and dam on Rough River, Kentucky (Appendix I I 9).

References to more extended information may be found in Annual Report of the Chief of Engineers, 1904, page 501.

Sufficient data are not available upon which to determine the effect of the improvement on freight rates, if any.

July 1, 1906, balance unexpended.....	\$600. 71
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	493. 92
July 1, 1907, balance unexpended.....	106. 79
July 1, 1907, outstanding liabilities.....	17. 27
July 1, 1907, balance available.....	89. 52

(See Appendix I I 8.)

9. *Operating and care of lock and dam on Rough River, Kentucky.*—This lock and dam was built with funds provided in appropriations for improving Rough River, Kentucky, and opened to

navigation December 12, 1896. The lock has an available length of 123 feet, width of 27 feet, and depth on upper miter sill at normal pool stage of 6.8 feet. At such stage the pool above the lock affords slack-water navigation  $21\frac{1}{2}$  miles to a short distance above Hartford, Ky., for boats with draft not exceeding 4 feet.

The expense of operating the lock was paid from the appropriation for improvement until June 30, 1897; since that date the expenses of operating, care, etc., have been borne by the indefinite appropriation for operating and care of canals and other works of navigation, act of July 5, 1884, the funds being made available by allotment for projects and estimates submitted annually at the beginning of each fiscal year.

The project for the fiscal year 1907 proposed to operate the lock and maintain existing structures in good serviceable condition and keep the channel clear of snags, etc., at an estimated cost of \$1,509.95, which amount was made available by allotment July 12, 1906. Expenditures during the year amounted to \$1,245.62.

The amount expended from July 1, 1897, to June 30, 1907, not including outstanding liabilities, is \$8,731.31.

Traffic through the lock during the past fiscal year included 855 boats of various kinds, carrying 30,984 tons of freight. A comparative statement of traffic and commerce on this river during the past sixteen years will be found in the report on this work by the district officer.

(See Appendix I I 9.)

#### IMPROVEMENT OF RIVERS AND HARBORS ON LAKE SUPERIOR.

This district was in the charge of Maj. Chas. L. Potter, Corps of Engineers, to August 3, 1906, and in the charge of Maj. Graham D. Fitch, Corps of Engineers, since that date. Division engineer, Lieut. Col. W. H. Bixby, Corps of Engineers.

1. *Harbor at Grand Marais, Minn.*—This harbor is an elliptical bay, whose major axis is about one-half mile and whose minor axis is about one-fourth of a mile in length. It has an opening on the south side, which was originally about 1,000 feet in width. Before improvement there was a maximum depth of 14 feet over a very limited area, the general average depth being only 8 or 9 feet. It is the only harbor of refuge on the north shore between Agate Bay and the international boundary line, a distance of 125 miles.

The approved project of April, 1879, is to build two breakwater piers, each 350 feet long, from the east and west points of the bay, or one pier 700 feet long from the east point, and dredge an anchorage area of about 26 acres to a depth of at least 16 feet, all at an estimated cost of \$139,669.40. For reasons explained in the report of the local officer (Annual Report of the Chief of Engineers for 1898, p. 2217), this estimate was increased to \$163,954.63.

Two breakwaters, each 350 feet long, have been constructed from the east and west points of the bay, the work being completed on August 13, 1901.

The amount expended on the project up to the close of the fiscal year ending June 30, 1907, not including outstanding liabilities, was \$165,686.68, of which about \$4,750 was for maintenance. The work done has resulted in a more protected harbor and a 16-foot anchorage area of about 26 acres.

The minimum mean low-water depth over the shoalest part of the locality under improvement is 15 feet.

The usual variations of water level extend from about 0 to +1 foot above low-water datum.

The commerce of the port has increased from 25 entrances and clearances, made by 4 tugs and 5 schooners, with 60 tons of cargo, valued at \$6,000, in 1878, to 1,224 clearances and entrances, nearly all steamers, with 30,910 tons of cargo, valued at \$970,083, in 1906.

The value of the commerce of the harbor from 1878 to 1906, both inclusive, is estimated at \$7,890,479.

The freight tonnage in 1906 was 62 per cent less than in 1905.

Effect of project on freight rates: There are no railroads running to this harbor, and the only means of transportation is by water, so that no comparison can be made with railroad charges.

In the original condition of the bay a small commercial business could have been transacted by means of tugs or other vessels of small draft at risk of exposure to storms, and logs could have been rafted to other ports on the lake, also at risk of loss, to be sawed into lumber; but the present commerce of this port could not have been carried on.

The United States improvements have therefore been an indispensable agency in the development of business where none previously existed, and this may be of greater value and importance than a simple reduction of rates.

The available balance will be expended for repairs and maintenance. The renewal of worn-out deck covering on the east breakwater at a cost of about \$1,500 will be made prior to June 30, 1908, and the balance held subject to damage by storms and vessels, and other expense of maintenance.

For reports of examinations and surveys see Annual Report of the Chief of Engineers for 1906, page 559, where references are given.

July 1, 1906, balance unexpended .....	\$1,800.34
Amount appropriated by river and harbor act approved March 2, 1907 ..	5,000.00

	6,800.34
June 30, 1907, amount expended during fiscal year, for maintenance of improvement .....	137.02

July 1, 1907, balance unexpended .....	6,663.32
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(See Appendix J J 1.)

2. *Harbor at Agate Bay, Minnesota.*—This important harbor, situated on the north shore of Lake Superior, 27 miles northeast of Duluth, Minn., is a shipping port for iron ore and lumber and a harbor of refuge.

Before improvement there was ample depth for navigation, but the harbor was exposed to storms from the southwest and to reverse swells from severe northeast storms.

The approved project of January 4, 1887, was to construct two breakwater piers on a line toward each other from the eastern and western points of the bay, to be 1,000 and 900 feet long, respectively, leaving an opening of 1,340 feet between their extremities and inclosing an area of 109 acres.

By letter of the Chief of Engineers, March 23, 1899, the total ultimate length of the easterly breakwater was increased by 50 feet.



The original estimate of cost was \$213,000, which was increased to \$244,208 in Annual Report of 1887 on account of higher prices.

The amount expended on the approved project up to the close of the fiscal year ending June 30, 1907, not including outstanding liabilities, was \$250,657.53, of which about \$16,600 was applied to the maintenance of the improvement.

The project was completed on November 1, 1901, and fulfills very effectually the purpose for which it was designed.

The depth at the entrance is over 50 feet, and vessels drawing 20 feet can reach the ore docks in safety.

The usual variation of water level extends from about 0 to about +1 foot above low-water datum.

The commerce of the port has increased from 174 arrivals and clearances of vessels in 1885, with 263,437 tons of freight, valued at \$876,613, to 3,918 arrivals and clearances in 1906, with 9,566,874 tons, valued at \$28,697,943.

The total value of the commerce of this port from 1887 to 1906, both years inclusive, is \$160,790,177.

Effect of project on freight rates: It is estimated that the saving in cost of transportation by water as compared with that by rail for the receipts and shipments of this harbor is approximately \$1.79 per ton, which amounts to \$17,000,000 for the year 1906. This is more than one-half of the value of the receipts and shipments for the same year. The Government improvements have been an indispensable aid to this commerce. (See the following report of the Chief of Engineers for harbor at Duluth, Minn., and Superior, Wis.)

The available balance will be expended for repairs and maintenance. Repairs to the east breakwater on account of decay and damage by storm and injuries by vessels were completed in June, 1907, at a cost of about \$1,800, and the remaining funds will be held for repairing damages by storms and vessels and for other expenses of maintenance.

For reports of examinations and surveys, see Annual Report of the Chief of Engineers for 1906, page 561, where references are given.

July 1, 1906, balance unexpended.....	\$659. 01
Amount appropriated by river and harbor act approved March 2, 1907.....	4, 000. 00
	4, 659. 01
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	2, 542. 35
July 1, 1907, balance unexpended.....	2, 116. 66
July 1, 1907, outstanding liabilities.....	9. 45
July 1, 1907, balance available.....	2, 107. 21
(See Appendix J J 2.)	

3. *Harbor at Duluth, Minn., and Superior, Wis.*—Previous to the Annual Report of 1897 this harbor was reported on under the separate heads of Duluth, Minn., and Superior, Wis., respectively.

The act of June 3, 1896, unified these harbors under the above title and provided for continuous contracts for its improvement to the amount of \$3,130,553.

This harbor consists of the Duluth Canal, the Wisconsin Entrance, Superior Bay, Allouez Bay, St. Louis Bay, and St. Louis River to the limits of the cities of Duluth and Superior, about 20 miles from the

original natural entry, which before improvement was obstructed by shifting bars with but 9 feet of water over them. The bays were broad expanses of shallow water, averaging only 8 or 9 feet, except along a natural channel through them where the depth was greater, but variable.

The project adopted by the act of March 3, 1881, previous to the present one, was for 16-foot navigation. This was practically completed July 1, 1897, and resulted in giving a good 16-foot navigation through the natural or Wisconsin Entry; through the artificial Duluth Canal; over the Duluth Basin of 104 acres; along and parallel to the principal dock lines of Duluth and Superior in Superior and St. Louis bays, and up the St. Louis River to New Duluth, near the head of navigation of the river, with well-defined channels of from 85 to 300 feet in width.

The amount expended on the project of March 3, 1881, and projects prior to operations under existing project was \$1,548,183.

The present project, authorized by the act of June 3, 1896, and by the modifications of August 14, 1896, and May 9, 1901, provided for the widening and deepening to a navigable depth of 20 feet of the existing channels, for new channels in Allouez Bay and St. Louis River, for extensive turning and anchorage basins of a navigable depth of 20 feet at the junctions of two or more channels, for widening the Duluth Canal, and for rebuilding the piers at the Duluth Canal and Wisconsin Entrance and finishing them off with concrete superstructures built of monolithic blocks.

The estimated cost of the work was \$3,130,553, but this referred only to the deepening of the channels and basins by dredging. This has been done at much less than the estimated cost, permitting the purchase of lands to the extent of \$106,561.19, the rebuilding of the Duluth Canal piers at a cost of over \$650,000, including price of land, and leaving a balance of about \$275,000 toward the rebuilding of the piers at the Wisconsin Entrance now under construction.

The present project has been further modified and enlarged by the act of March 2, 1907, in accordance with the report submitted in House Document No. 82, Fifty-ninth Congress, second session, which provides for excavation of the lake approach to the Duluth entrance to 30 feet for a width of 300 feet at a cost of \$10,000, and the following work at Superior Entry: (a) Building a concrete revetment pier on the north side of entrance, similar to one already built in 1904, on the south side under the project before present modification, these two revetments 500 feet apart and terminating near the lake shore of Wisconsin Point; (b) building two converging breakwaters from the shore out to the 30-foot depth, with an opening of 600 feet on line with the axis of the inner entrance, to be of rubble mound construction, terminating in a crib and concrete pier at outer end and a pile pier at inner end; (c) dredging between the breakwaters to form a channel 600 feet wide and 30 feet deep, and further dredging to form a stilling basin; (d) dredging channel between revetments to a depth of 24 feet; (e) protecting the shore line by riprap; and (f) widening the Superior front channel inside the harbor; estimated to cost \$1,703,000. The said act also provided for additional dredging near the draw span of the Northern Pacific Railroad bridge at an

estimated cost of \$55,500. The total cost of these modifications is estimated at \$1,768,500.

The amount expended on the existing project to the close of the fiscal year ending June 30, 1907, exclusive of outstanding liabilities, was \$3,473,414.92, of which \$345,600 was expended for maintenance.

The work done under the existing project up to the close of the past fiscal year has been as follows:

The dredging of channels and basins, which was in operation for six seasons under continuous contract, was completed in 1902 and 21,697,243 cubic yards of material removed. Since then some shoals have been removed.

All the land necessary for the widening of the Duluth Canal has been acquired by deed of gift, purchase, or condemnation, at a cost of \$53,919.05.

The land needed for the improvement at the Wisconsin Entrance, the mouth of the Nemadji River, and on a marshy island in the St. Louis River, was obtained by condemnation proceedings, at a cost of \$42,795.94.

A small parcel of land at the end of Grassy Point and certain lands in Spirit Lake were purchased, at a cost of \$3,146.20.

A site for a boat yard on Minnesota Point, near the Duluth Canal, was acquired by purchase and condemnation, at a total cost of \$7,200, and the vacation of a portion of a street was effected through the city authorities, which was found necessary in order to carry out a proper system of improvement. This property has now been improved by building a bulkhead and a landing pier, dredging a slip, filling the yard with sand, moving the four Government buildings, which had been occupying leased ground at the foot of Seventh avenue for the last seven years, and by fencing in, paving a roadway, and surfacing and seeding for grass. The cost of this improvement has been about \$17,750.

New piers were built for the Duluth Canal. These piers have been equipped with 67 iron lamp-posts, and the city furnishes the electric current for lighting the same during the season of passenger travel by lake.

Concrete walls inclosing the Government lands at the Duluth Canal were built and the tracts filled to grade, requiring the deposit of about 50,000 cubic yards of material.

The construction of an engineer building on the Government land north of the canal for offices and a watchman's house has been completed, at a cost of about \$25,000. On May 1, 1906, the rented office rooms were given up and the new building occupied. It is a substantial building, conveniently near the harbor and United States vessel yard, and well adapted to office purposes. The parking of the canal grounds and the construction of additional concrete walls to protect the grounds from flooding by storms are in progress.

The piers at the Wisconsin Entrance were placed, about thirty-two years ago, in water of an average depth of 8 to 10 feet, the object then being to secure a depth of 12 feet in the channel. With the growth of commerce the channel depth has been increased to 24 feet, and the crib bottoms are now many feet above the bottom of the channel.

Owing to this and other causes, considerable displacement resulted, and the replacing of the old piers by new ones of concrete construction was begun in 1903. About one-half of the south pier was completed in 1904. A description of the method of construction may be seen in Appendix A A A, page 3779, of the Annual Report of the Chief of Engineers for 1904. During the following two years but little was accomplished in the way of construction at the Superior Entry on account of the destruction of protective works by storms. Work on the concrete piers was ordered discontinued by the Chief of Engineers August 21, 1906, pending the consideration of a report by a Board of Engineers. Work on the modified project of April 5, 1907, was commenced in the spring of 1907 by the excavation of a pier trench for the concrete revetment, which is now in progress, and steps have been taken for the construction of the breakwaters and for some of the dredging at the lake approach to the entrance. Riprap is being removed from the old entrance piers and deposited in the south rubble mound breakwater.

The dredging operations, which were completed November, 1902, have given 17 miles of dredged channels from 120 to 600 feet in width and basins of an aggregate area of about 360 acres, all of a depth of 20 feet or more at low water, which must be maintained by dredging as needed. Shoaling has occurred in the vicinity of the Nemadji River, caused by deposits brought down by flood waters, which requires occasional dredging. The present available depth at that point is 18 feet.

The usual variation of water level extends from about 0 to +1 foot above low-water datum.

The head of navigation is at the foot of the rapids just above the village of Fond du Lac, on the St. Louis River, about 20 miles from Lake Superior.

The improvements made are in excellent condition, and the expenditure has been amply justified by the immense commerce which it has readily accommodated.

The additional work proposed is for the purpose of extension of benefits by increasing facilities of navigation and making present improvements more premanent in character.

The lake commerce of this port, Duluth-Superior, during the last season of navigation amounted to 29,171,221 tons (of 2,000 pounds), valued at \$251,899,844, and from the beginning of improvements by the Government in 1867 to 1906, inclusive, the vessel freight entering and departing has amounted to 207,395,267 tons (of 2,000 pounds), valued at \$2,593,135,606.

It is believed that the tonnage of Duluth-Superior Harbor is now exceeded by that of but two ports in the United States—New York and Philadelphia.

The vessel freight of Duluth-Superior Harbor for 1906 was 56 per cent of the amount which passed the Sault locks the same year.

For a comparison between the cost of improvements and the volume of commerce it may be stated here that the total amount of money expended by the Government on the improvement of this harbor from the commencement of work in 1867 up to 1906, inclusive, is \$5,021,597.92. The vessel freight received and shipped at this port during the same period was 207,395,267 tons and its market value was \$2,593,135,606. From this it appears that the cost of Government

improvements has been less than one-fifth of 1 per cent of the value of the freight transported.

Effect of project on freight rates: It may not be possible to give exact figures showing the effect of the improvements of this harbor on freight rates, but the following statements have a bearing on the question:

The average rate on freight passing through St. Marys Falls canals in 1906 was 0.84 mill per mile per ton, and the average haul was 842.4 miles, as shown by the official records. If the same freight had been carried by rail, the rate would probably have been as much as 3 mills per ton-mile, making a difference of 2.16 mills per ton-mile.

Assuming this difference to apply to freight for Duluth-Superior Harbor and that the average haul is 842.4 miles, the saving in cost of transportation by water would be \$1.79 per ton, and for the 29,171,221 tons received and shipped at this harbor in 1906 the saving in cost amounts to \$52,000,000 in that one year.

The saving in cost of this large sum has, of course, been made possible by the Government improvements, not only at this harbor, but at St. Marys River and at other points between here and the Lake Erie ports, and it is not known just how much of the above saving should be credited to the Duluth-Superior improvements. It is evident, however, that with any reasonable proportion of such saving in transportation accredited to the improvements at this harbor, which forms an essential and necessary part of the whole waterway, the cost of such improvements must be only a small fraction of the saving in freight rates effected thereby.<sup>a</sup>

The foregoing relates to the general subject of freight rates, whether by rail or water, between Lake Superior and the lower lakes. The effect of projects for harbor improvement upon railroad freight rates can not be so definitely stated. The two kinds of transportation have developed contemporaneously during the last half century or longer, and it would be hard to say what the railroad rates would be if the Great Lakes waterway or the local harbor improvements did not exist, but there is hardly room for doubt that they would be materially higher.

For the business between points along the south shore of Lake Superior the railroads reduce their rates during the season of navigation in order to compete with the lake lines of vessels. Thus the Northern Pacific makes a rate from Duluth to Ashland practically the same as by the Booth line of steamers, and the South Shore road makes a rate from Duluth to Marquette only about 2 cents per hundred higher than by lake. On business between Duluth and the Lake Erie ports, however, the railroads say they can not afford to compete with lake rates, and their rates are not changed during the summer.

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<sup>a</sup> A similar saving in freight rates applies to other harbors in the Duluth district which have railroad connections and where harbor improvements executed by the Government (or in part at private cost) have opened up these harbors to interlake navigation and commerce. The above-named amount of saving in cost of transportation, \$1.79 per ton, will be considered as applying approximately to the harbors of Agate Bay, Ashland, Ontonagon, Marquette, Marquette Bay, and Grand Marais (Mich.), subject to more or less error, according to different local conditions, such as the class of freight, its destination, number of competing railroads, facility of handling freight by boat and by rail, etc. A complete analysis of the subject can not, however, be given in this report.

A prominent wholesale merchant of Duluth says on this subject:

Owing to the enlarged facilities of the different lake transportation companies, freight of all classes is now handled with as good dispatch and with less shipping damage from one lake terminal to the other lake terminal as shipments by all rail. There is and has been for some time a differential in rates in favor of lake shipments, and it is a noticeable fact that the bulk of all kinds of merchandise and other freight originating at or anywhere near terminal lake points are transported almost exclusively by water.

There is no question in my mind that the rates of transportation by lake have a tendency to keep down and in line rates by rail. Furthermore, it is freely admitted that on eastbound shipments of grain the railways would be at least 50 per cent higher were it not for the fact of the accommodation, dispatch, and low rates to be had by lake and lake and rail.

By whatever amount the railroad charges are lessened by the proximity of the lake route, the saving in cost of transportation by lake given on the preceding page is increased by the same amount.

With regard to the maintenance of improvements in this harbor, it is believed that this could be advantageously provided for by an annual allotment.

With 49 miles of harbor frontage, 17 miles of 20-foot channels, and the handling of over 29,000,000 tons of freight annually, there is necessity for the closest inspection, by a special patrol provided with a steam tug, to prevent injurious deposits, encroachments of wharves and other private structures, the enforcement of rules regarding the rafting of logs, the anchorage of vessels, the opening of draws, and the care of United States property. These, with the discovery and removal of shoals, repairs to Government piers, the care of parks, and the collection of complete and reliable commercial statistics, which has already proven of great value, it is thought could best be cared for by Congressional action authorizing allotments or appropriations to be made on estimates submitted.

A Board of Engineers convened July 23, 1906, at Duluth, with a view to determining what modifications, if any, should be made in the present plan of improvement. The report of this Board is printed in House Document No. 82, Fifty-ninth Congress, second session.

For other reports of examinations and surveys of Duluth-Superior Harbor, see the Annual Report of the Chief of Engineers for 1906, page 565, where references are given.

July 1, 1906, balance unexpended.....	\$333, 962. 42
Amount appropriated by river and harbor act approved March 2, 1907.....	725, 000. 00
Amount appropriated by sundry civil act approved March 4, 1907.....	200, 000. 00
Miscellaneous receipts, sales, etc.....	2, 000. 00
	<hr/> 1, 260, 962. 42
June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$75, 479. 60
For maintenance of improvement.....	30, 677. 24
	<hr/> 106, 156. 84
July 1, 1907, balance unexpended.....	1, 154, 805. 58
July 1, 1907, outstanding liabilities.....	20, 000. 00
	<hr/> 1, 134, 805. 58
July 1, 1907, balance available.....	
July 1, 1907, amount covered by uncompleted contracts.....	55, 000. 00
Amount (estimated) required for completion of existing project.....	827, 999. 20

(See Appendix J J 3.)

4. *Harbor at Port Wing, Wis.*—The harbor of Port Wing, formed by the mouth of Flag River, is situated on the south shore of Lake Superior, about 33 miles from the head of the lake.

Before improvement the depth at entrance was small and variable.

Previous to Government operations the harbor had been improved by private parties to some extent. The entrance had been jettied, but imperfectly and with only partial success, and dredging was necessary every spring for removing a sand bar. Within the harbor much dredging had been done to accommodate the lumber business.

In accordance with the provisions of the act of Congress approved March 3, 1899, a report upon a survey of this harbor with a project for its improvement was submitted on November 20, 1899.

This project provided for the construction of two parallel piers of piling, filled in with slabs and topped with large rock. These piers were to be located 200 feet apart and to be 800 feet and 825 feet long, respectively. A channel 150 feet wide and 15 feet deep was to be dredged between the piers and for 500 feet along the slough. The estimated cost of the improvement was \$44,992.

By act of Congress approved June 13, 1902, this project was adopted and the sum of \$25,000 was appropriated, provided the United States should, before the commencement of operations, be given clear title, without cost, to all lands needed for the improvement.

This provision was complied with by a deed to the United States, dated July 9, 1902, conveying 7 acres of land at the harbor entrance.

Under the approved project work was begun June 1, 1903. The east pier was built in that season. In the same season and the following dredging was done to the extent of 39,374 yards, which nearly exhausted the funds appropriated. This dredging gave an entrance channel 15 feet deep at low water, 100 feet wide, and extending from deep water in the lake through to a distance of 100 feet inside of the inner end of the east pier. A small portion of the proposed turning slip was also dredged 30 feet wide and to a distance of 50 feet.

The river and harbor act approved March 3, 1905, appropriated \$19,992 for completing the improvement and for maintenance.

The west pier at the entrance was built between the dates of June 28, 1905, and November 6, 1905. Length, 601 feet. Contract cost, \$13,929.

These piers have been effective in reducing shoaling very materially.

Private dredging extended a navigable channel to a distance of about 2,500 feet southerly from the main entrance. Navigation is limited to this improved stretch of Flag River. The upper portion of this stretch has shoaled much by the deposit of sediment carried by the river.

The amount expended on this work to the close of the fiscal year ending June 30, 1907, exclusive of outstanding liabilities, was \$42,013.95, of which \$1,550 was for maintenance. Further dredging is required to complete the project, however.

No additional improvement is considered advisable under present conditions of the harbor and its commerce, but provision should be made for maintenance.

The usual variation of water level extends from about 0 to +1 foot above low-water datum.



The greatest maximum draft that can be carried through the entrance (by soundings of April, 1907) is  $11\frac{1}{2}$  feet at low water. The effective width is narrow.

The vessel freight of this harbor has decreased from 64 arrivals and departures, with 31,127 tons (of 2,000 pounds), valued at \$305,000 in 1901, to 316 arrivals and departures, with 28,611 tons (of 2,000 pounds), valued at \$345,448 in 1906.

The freight tonnage in 1906 was 35 per cent less than for the previous year.

The total freight of this port for six years—1901 to 1906, inclusive—was 241,073 tons (of 2,000 pounds), valued at \$3,169,756.

Effect of project on freight rates: This harbor has only water transportation for the movement of its freight, and for this reason no comparison can be made with freight charges by railroad.

The construction of a harbor here has been an essential factor in the development of the commerce of Port Wing. There was no commerce to mention previous to these improvements. In 1905 it amounted to over a third of a million dollars.

It is proposed to expend the available balance for repairs to entrance piers, the removal of shoals, and for maintenance.

A more detailed description of the harbor may be seen in House Document No. 114, Fifty-sixth Congress, first session, and in Bulletin No. 17, Survey of the Northern and Northwestern Lakes, page 71.

For reports on examinations and surveys, see Annual Report of the Chief of Engineers for 1906, page 568, where references are given.

July 1, 1906, balance unexpended.....	\$3, 528. 61
Amount appropriated by river and harbor act approved March 2, 1907.....	2, 000. 00
	<hr/>
	5, 528. 61
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	550. 56
	<hr/>
July 1, 1907, balance unexpended.....	4, 978. 05
	<hr/>
July 1, 1907, amount covered by uncompleted contracts.....	4, 700. 00

(See Appendix J J 4.)

5. *Harbor at Ashland, Wis.*—Ashland Harbor is located at the head of Chequamegon Bay, and originally had no protection from the waves which rolled into the bay nor from waves generated within the bay itself by storms.

The original project, approved December 7, 1888, and modified February 9, 1889, was for the construction of a pile, slab, and rock breakwater 8,000 feet long, and for dredging a channel in front of the wharves of the city. The act of March 3, 1899, added to this project by authorizing an extension of the breakwater to the shore, thus requiring the ultimate construction of 10,200 feet of breakwater. The emergency river and harbor act of June 6, 1900, provided that the appropriation already made should be expended in building a shore spur 4,700 feet in length from a point 2,600 feet east of the prolongation of the present breakwater and parallel thereto. This again changed the project, adding greatly to the total length of breakwater to be constructed and largely to the total expense.



Under this project and its two modifications there have been constructed 7,454 feet of breakwater on the original line and 842 feet on the line fixed by the act of June 6, 1900.

Of the 7,454 feet on the original line 91 feet is detached and uncompleted work near shore and 7,363 feet is completed breakwater in one piece.

The total amount expended on this project and its modifications up to the close of the fiscal year ending June 30, 1907, not including outstanding liabilities, is \$349,154.63, of which amount \$162,389 has been applied to the maintenance of the improvement.

The work done gives a protected area of about 1,600 acres and affords safe anchorage and dockage for a distance of 3 miles along the city front.

The usefulness of the breakwater was in evidence when the northeast storm of September 2-3, 1905, caused considerable damage to the village of Washburn, across the bay from Ashland, breaking in 10 of the doors of the large flour shed of the Northwestern Railway Company and cutting away the embankment of the railroad approach, while the numerous docks along the Ashland Harbor front under the protection of the breakwater escaped injury. This storm seriously damaged the breakwater itself along the portions which had not been strengthened by the rock embankment.

The pile, slab, and rock breakwater on the original line is in very poor condition, and has required large expenditures for maintenance.

The work of revetting this structure with riprap so as to form a permanent rubble-mound breakwater, with the old structure for a hearting, was begun in May, 1903, and has continued with more or less work each year up to the present date, under two successive contracts. Under each of these contracts the plant was small and the rate of progress rather slow, but the low prices obtained under competitive bids compensated in a measure for the greater length of time required. A diagram showing the method of reenforcing the breakwater may be seen in the Annual Report of the Chief of Engineers for 1905, page 1992.

This work of maintenance, by strengthening the breakwater, is deemed of much importance at the present time, and should be prosecuted continuously until the entire 7,363 feet of main breakwater is revetted.

A channel was dredged by the United States in 1897 and extended in 1903 along the harbor front from the natural deep water near Ellis avenue and the Commercial dock westerly to the Barker & Stewart lumber docks, a distance of about 4,360 feet. This channel has a width of from 90 to 140 feet, in which the maximum draft that can be carried is 18 feet at mean low water. (See map in Annual Report of the Chief of Engineers for 1903, page 1812.)

The usual variation of level of the water surface extends from about 0 to +1 foot above low-water datum.

The commerce of this port consists principally of iron ore and lumber exported, and coal, mineral oil, and general merchandise imported.

The commerce has increased during the nineteen years the harbor has been under improvement by the United States from 892 arrivals and clearances, with cargo tonnage of 1,400,000 tons (of 2,000 pounds)

in 1887, to 2,102 arrivals and clearances, with cargo tonnage of 4,910,031 tons (of 2,000 pounds), valued at \$20,793,478 in 1906. The total commerce from 1887 to 1906, inclusive, is estimated at 65,092,481 tons (of 2,000 pounds), valued at \$485,029,682, exclusive of logs towed in rafts.

Effect of project on freight rates: The estimated saving in cost of transportation by water over that by rail is \$1.79 per ton, or over \$8,000,000 for the business of this port in 1906. (See also page 590 of this report.)

The protection to this commerce afforded by the Government improvements is fully stated in another part of this report.

On June 30, 1907, the total distance revetted was 3,689 linear feet, making about one-half of the entire length of the breakwater. The present contract will probably be completed about the middle of August, 1907. A third contract, dated June 27, 1907, has been entered into for continuing this work, with money appropriated March 2, 1907. This will be for the delivery of about 70,000 tons, and is to be completed by December 1, 1908. As nearly as can be estimated now this will not complete the entire breakwater.

A contract has been entered into for dredging to extend the Government channel in front of the wharves of the city westward about 1,400 feet, with a depth of at least 20 feet and a width of 100 feet. The cost will be about \$9,000. Under the same contract shoals will be removed from the present channel at a cost of about \$6,000. The work is expected to be done in August and September, 1907.

The dredged material, or a portion of it, will be dumped alongside the breakwater to form a part of the embankment on which the rip-rap will rest.

For reports on examinations and surveys see Annual Report of the Chief of Engineers for 1906, page 570, where references are given.

July 1, 1906 balance unexpended.....	\$48, 735. 05
Amount appropriated by river and harbor act approved March 2, 1907.....	90, 000. 00
	<hr/>
	138, 735. 05
June 30, 1907, amount expended during fiscal year, for maintenance of improvement .....	23, 389. 68
July 1, 1907, balance unexpended.....	115, 345. 37
July 1, 1907, outstanding liabilities.....	3, 101. 78
	<hr/>
July 1, 1907, balance available.....	112, 243. 59
	<hr/>
July 1, 1907, amount covered by uncompleted contracts.....	26, 300. 00
Amount (estimated) required for completion of existing project.....	311, 500. 00
(See Appendix J J 5.)	

6. *Harbor at Ontonagon, Mich.*—The entrance to Ontonagon River, which forms the harbor, had but 7 feet depth in 1867, at which time the project for securing 12 feet depth by building parallel piers on either side of the mouth, extending to the 18-foot curve of depth in Lake Superior, and dredging a channel between the piers, was adopted. The west pier was built to a length of 2,675 feet and the east pier to a length of 2,315 feet. This brought the outer end of the west pier very nearly to the 18-foot curve of depth, as proposed.

As far as new work is concerned, the project has been completed since 1889, and further expenditure will be needed only for keeping a 12-foot channel open by dredging and for the repairs to the piers.

The amount expended on this improvement up to the close of the fiscal year ending June 30, 1907, not including outstanding liabilities, is \$363,525.52, of which sum \$78,725 has been spent for maintenance of the improvement.

The history of this harbor shows that when completed and dredged in 1891 it had a somewhat narrow channel depth of 16 feet between the piers, but this gradually shoaled to 12 feet, and in 1894 dredging was done to the extent of 33,817 cubic yards to provide for 12-foot navigation. No further dredging was necessary until 1903, when 18,054 cubic yards was dredged to provide a channel 100 feet wide, with a least depth of 15 feet.

During the past three years the shoaling has been abnormal, and in addition to the last two appropriations of \$3,000 and \$5,000, respectively, made by Congress, three allotments, two of \$5,000 each and one of \$10,000, have been made from the emergency appropriations. The dredging done in the fiscal years 1905 and 1906 to give navigation the barest needs was more than all other dredging since 1891. This dredging provided a channel 60 feet wide and 14 feet deep between the piers, with a narrow channel 13 to 14 feet deep to each dock. This gave much relief to navigation, but the channel was still entirely insufficient for the commerce of the harbor.

A survey made in May, 1907, showed additional very extensive shoaling, dredging for the removal of which began on June 15, 1907, and is now in progress.

The Ontonagon River brings down in flood large quantities of material which rapidly fill up the harbor. While these floods do not occur every year, provision should be made for relieving the situation when they do occur.

Money should be appropriated to restore this harbor to its condition in 1891, or even better, and the succeeding appropriations should be sufficient to provide for the barest needs of two flood years in the Ontonagon River.

In addition to these, some repairs will be needed on the west pier.

The usual variation of water level extends from 0 to +1 foot above low-water datum.

In 1867 there were 449 arrivals and departures, with 5,000 tons of cargo, and in 1906 there were 390 arrivals and departures, with 21,411 tons (of 2,000 pounds) of cargo, valued at \$797,047.

The commerce of this port since the commencement of operations by the United States is estimated at 2,787,671 tons (of 2,000 pounds), valued at \$74,766,002.

The amount of freight received and shipped in the calendar year 1904 was more than twice that of 1903; in 1905 the commerce was again nearly doubled, and in 1906 it shows a decrease.

Effect of project on freight rates: The estimated saving in cost of transportation by water over that by rail is \$1.79 per ton, or \$38,325 for the lake commerce of this port in 1906. (See also p. 590 of this report.) As the former condition of the river was unsuited to navigation, this saving in freight rates may be considered as effected by United States improvements.

For reports on examinations and surveys, see Annual Report of the Chief of Engineers for 1906, page 571, where references are given.

July 1, 1906, balance unexpended.....	\$102. 40
Amount appropriated by river and harbor act approved March 2, 1907..	5, 000. 00
Amount allotted from appropriation for emergencies for river and harbor works, act March 2, 1907.....	10, 000. 00
	<hr/>
	15, 102. 40
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	499. 92
	<hr/>
July 1, 1907, balance unexpended.....	14, 602. 48
	<hr/>
July 1, 1907, amount covered by uncompleted contracts.....	12, 500. 00

(See Appendix J J 6.)

7. *Waterway across Keweenaw Point, from Keweenaw Bay to Lake Superior, Michigan.*—This work was formerly reported on as the Portage Lake and Lake Superior canals, across Keweenaw Point, Michigan.

In accordance with the provisions of the river and harbor act of September 19, 1890, the United States purchased and assumed the charge and care of these canals on August 3, 1891.

At the time of the purchase by the United States there was a very poor 13-foot navigation; the channel was narrow and crooked, with many sharp bends; it was poorly marked and lighted; the entrance piers were in a very bad condition; the revetments were decayed or entirely gone, and there was a tax on the commerce through the canals in the shape of a tonnage charge.

The original project, adopted January 24, 1887, was—

1. For a 16-foot channel of 70 feet bottom width from bay to lake.
2. A renewal of the canal revetments.
3. A reconstruction of the piers at the Lake Superior entrance and their extension to 30 feet depth of water.
4. The extension of the pier at the Keweenaw entrance to a 20-foot depth of water.

5. At the proper time to increase the channel depth to 20 feet, with a corresponding width, which should not be less than 120 feet.

The sum expended in the purchase of the canals, lands, etc., and on items 1 and 2 of the original project was \$850,000.

The act of June 3, 1896, authorized continuing contracts to complete items 1, 2, 3, and 4 of the above project to the amount of \$1,115,000.

By modification approved March 15, 1898, the width and depth were to be increased to 120 feet and 20 feet, respectively, as originally contemplated.

The total amount expended on the original project and its modifications up to the close of the fiscal year ending June 30, 1906, not including outstanding liabilities, was \$1,325,347.86, of which about \$28,600 was expended for maintenance.

With the termination of the dredging contract in 1903 the funds appropriated for the improvement of this waterway were practically exhausted.

The project at this time was not fully completed, there being two localities where the width was less than 120 feet, and some revetment

work remained to be done. The cost of completion was estimated at \$45,000.

It should be remembered that the appropriations made and authorized June 3, 1896, amounting to \$1,115,000, were for the original project, which provided for a 16-foot channel 70 feet wide. When the project was modified in 1898, increasing the depth to 20 feet and the width to 120 feet, there was no increase made in the estimate of cost, as it was thought by the officer in charge that with the lower prices resulting from the continuing appropriations the additional width and depth could be obtained with the \$1,115,000 already provided for. This, it will be seen by the foregoing, was almost realized, lacking only \$45,000, and the said amount appropriated and expended (\$1,115,000) is about \$715,000 less than the original estimate for the modified project.

The act of March 3, 1905, appropriated \$45,000 for continuing improvement. Under this appropriation 132,629 cubic yards was dredged under contract during the fiscal year ending June 30, 1906.

As a result of this work the waterway has a clear width of 120 feet and a clear depth of 20 feet throughout its entire length, while at Princess Point, a somewhat difficult bend in Portage River, there is a clear width at the point of 380 feet, and just below the point a clear width of 220 feet.

The available balance was intended for renewal of the old revetments, but it is believed that some of them, owing to their location in clay cuts, may not need renewal, and the money will be held until the necessity shall be demonstrated.

In addition to the approved project the district officer has represented as a further need of navigation the establishment near the lower end of the canal of a harbor of refuge similar to that known as the "Lily Pond," near the upper end. The work would be simple, involving only an enlargement of the canal and the construction of revetment, and is recommended as of great value to navigation.

A preliminary examination or survey hereon was authorized by the river and harbor act approved March 2, 1907, and it is expected that the report will be submitted to Congress in December, 1907.

The maximum draft that can be carried through the waterway at present is 20 feet at low water.

The usual variation of water level extends from about 0 to +1 foot above low-water datum.

During the navigation season of 1906 the commerce through this waterway amounted to 2,632,355 short tons of freight, valued at \$102,846,779, and 72,400 passengers. The increase in freight tonnage over that of the preceding year amounted to 9 per cent.

There was also a local business of about 100,000 tons of freight, valued at about \$1,000,000.

From the commencement of operations for improvement by the United States in 1891 to the close of the calendar year 1906 it is estimated that the total vessel freight entering and departing aggregated 23,697,490 tons (of 2,000 pounds), valued at \$755,412,142.

*Effect of project on freight rates.*—There is a large amount of freight shipped from towns on this waterway—Houghton, Hancock, Dollar Bay, Lake Linden, Hubbell, and Chassell—consisting of copper, lumber, etc., and freight received, consisting of coal, other sup-

plies, and general merchandise, on which the estimated saving of \$1.79 per ton in freight rates by water over railroad rates applies (see p. 590). The amount of this commerce can not be stated until next year, as the records kept by this office did not begin to separate the business of these towns from the commerce which simply passes through the waterway until 1907. This business would not be possible except for the improvements to this waterway, which the Government has either executed itself or paid for by purchase.

This waterway also serves a useful purpose as a harbor of refuge and is much used by vessels bound up or down, doing business at the head of the lake, particularly during the stormy season in the fall of the year. As many as 46 vessels have been tied up at one time at Lily Pond waiting for weather. By lessening the danger and risks of navigation in this manner, to whatever degree, makes this waterway to that extent a factor in the reduction of cost of transportation.

For reports on examinations and surveys, see Annual Report of the Chief of Engineers for 1906, page 574, where references are given.

July 1, 1906, balance unexpended.....	\$21, 009. 30
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	6, 119. 48

July 1, 1907, balance unexpended.....	14, 889. 82
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(See Appendix J J 7.)

8. *Operating and care of waterway across Keweenaw Point, from Keweenaw Bay to Lake Superior, Michigan.*—During the fiscal year ending June 30, 1907, the sum of \$9,250 from the permanent indefinite appropriation of July 5, 1884, was expended in repairs to the breakwaters and to the U. S. tug *Circle*, in superintendence and general operation of the canals, guarding against encroachments on the channels by private parties and corporations, on surveys and mapping of the waterway, and the collection of commercial statistics, etc.

An allotment of \$14,000 from the same source for the same purpose has been made for the fiscal year ending June 30, 1908.

For further details see the report on this work by the district officer.

(See Appendix J J 7.)

9. *Harbor at Marquette, Mich.*—This harbor, which had a natural depth of 18 feet or more, afforded no protection to vessels from easterly or northeasterly storms, and projects were approved in 1867 and 1888 for the construction of a breakwater composed of cribs filled with rock and projecting from the shore into the bay a distance of 3,000 feet. This breakwater was finished in 1894 practically as projected, but since its commencement extensive repairs have been made to the superstructure.

The amount expended up to the commencement of operations upon the new project was \$469,732.44.

A project for a concrete superstructure was approved February 27, 1890. Its estimated cost was \$232,936.71.

Work on this concrete superstructure was begun in the spring of 1895, and it is now built to a length of 2,920 feet, which is 97 per cent of the entire length. It is 100 feet short of the end of the old breakwater, and all that remains to complete the existing project is to build a pierhead and connect it with the finished work.

A preliminary examination and a survey of Marquette Harbor and vicinity, "with a view to ascertaining whether further harbor or refuge facilities are needed, and if so, at what point," authorized by the river and harbor act approved June 13, 1902, were made by the district officers, who express the opinion that greater refuge facilities are needed in this vicinity; that Marquette Harbor is the best place for such improvement, and that the additional shelter should be secured by extending the present breakwater for a distance of 1,500 feet at an estimated cost of \$303,000. The reports on this subject were transmitted to Congress by the Secretary of War December 16, 1903, and printed in House Document No. 161, Fifty-eighth Congress, second session. They are also printed in the Annual Report of the Chief of Engineers for 1904, Appendix I I, page 2786. The document is accompanied by a map of the harbor.

If provision be made by Congress for this extension, no pierhead will be required at the present end of the breakwater, but before beginning the extension the regular form of concrete superstructure would have to be continued over the gap of 100 feet which now remains. This would cost \$6,000, and the money could be taken from the funds now held in reserve for further improvement (\$21,391) awaiting the decision of Congress on this matter.

The amount expended on the new project up to the close of the fiscal year ending June 30, 1907, not including outstanding liabilities, was \$198,142.02, of which \$17,800 was spent for maintenance.

The work done has resulted in the protection of the ore, coal, lumber, and commercial docks from storms, and has shown the efficiency of the concrete breakwater.

Between the breakwater and the ore docks to the west there is generally from 20 to 30 feet of water, except at the northerly 400 feet of the harbor, where the depth at low-water datum is only 14 to 18 feet. This shallow water makes it difficult for vessels doing business at the ore docks at the north end of the harbor, besides somewhat restricting the area available for harbor of refuge purposes, and at least a portion of this area should be dredged to a clear depth of 21 feet at low-water datum.

For the maintenance of the breakwater the sum of \$10,000 should be appropriated biennially.

The usual variation of water level extends from 0 to + 1 foot above low-water datum.

The vessel commerce of this port has increased from 780 arrivals and clearances during the fiscal year ending June 30, 1872, with a registered tonnage of 370,000 tons, to 2,064 arrivals and clearances in 1896, carrying 1,332,061 short tons of freight, and 1,884 arrivals and clearances in 1906, carrying 3,055,014 short tons, valued at \$11,795,985. The total commerce from 1867 to 1906, inclusive, is estimated at 37,330,369 short tons, valued at \$165,665,765. This includes Marquette Bay.

Effect of project on freight rates: Taking the estimated saving in cost of transportation by water over that by rail as \$1.79 per ton, as on page 590 of this report, and the amount of vessel freight in 1906 as 1,119,395 tons (exclusive of the business done at Presque Isle), makes a total saving of over \$2,000,000 for the one year. This may be said to have been effected by Government improvements, as lake commerce could not otherwise be transacted at that locality.



The available balance (except \$21,391 held in reserve for further improvement) it is proposed to expend for maintenance.

For reports of examinations and surveys, see Annual Report of the Chief of Engineers for 1906, page 576, where references are given.

July 1, 1906, balance unexpended-----	\$3, 521. 62
Amount appropriated by river and harbor act approved March 2, 1907--	30, 000. 00
	<hr/> 33, 521. 62
June 30, 1907, amount expended during fiscal year, for maintenance of improvement-----	3, 807. 39
July 1, 1907, balance unexpended-----	29, 714. 23
(See Appendix J J 8.)	

10. *Harbor of refuge, Marquette Bay, Michigan.*—Marquette Bay, also known as Presque Isle Harbor, is a small bay within the city limits of Marquette, north of Marquette proper, and distant  $1\frac{1}{2}$  miles therefrom.

Before improvement the locality was fully exposed to storms from the east and northeast, and comparatively little shipping was done.

A resolution of Congress, approved March 20, 1896, directed the Secretary of War to make a survey and submit an estimate for a breakwater in this bay. The results of this survey, with estimates amounting to \$20,000 for breakwater 500 feet long and \$50,000 for construction of one 1,000 feet long, are published in House Document No. 318, Fifty-fourth Congress, first session.

The project adopted by the act of June 3, 1896, is to build a breakwater 1,000 feet in length off Presque Isle Point.

This breakwater was completed to its full length in July, 1900.

The act of Congress approved June 13, 1902, provided that a portion of the appropriation for Marquette Harbor "not exceeding seven thousand five hundred dollars may be expended in connecting the Presque Isle breakwater with the shore."

Under this provision the gap between the breakwater and shore was closed, in the fall of 1902, by a timber pier 216 feet long and 100 linear feet of shore revetment constructed.

No additional work is proposed except for maintenance.

The total amount expended on the project up to the close of the fiscal year ending June 30, 1907, not including outstanding liabilities, was \$57,597.34, of which \$2,541 was expended for maintenance.

The work done has enabled vessels to lie in safety at the ore pier and other docks in the vicinity, and shipping has increased greatly.

This harbor is largely used for commercial purposes, but to little or no extent as a harbor of refuge.

Vessels drawing 19 feet can reach the ore pier at mean low water.

The usual variation of water level extends from 0 to +1 foot above low-water datum.

The lake commerce of this port has increased from 1,110 arrivals and departures, with 1,095,243 tons of freight, in 1897, to 754 arrivals and departures, with 1,935,619 short tons, valued at \$5,407,598, in 1906. The total commerce from 1897 to 1906, inclusive, is estimated at 15,290,845 short tons, valued at \$40,120,397.

Effect of project on freight rates: The saving in cost of transportation by water of 1906 freight over the cost by rail, at the estimated figure of \$1.79 per ton, as on page 590 of this report, amounts to



\$3,465,000. This was made practicable by the Government breakwater at this locality. This harbor, as already stated, is not used for purposes of refuge, and it may be questioned whether its freight business could not have been transacted at Marquette, only 3 miles distant, where the Government had already constructed a harbor.

It is proposed to expend the available balance on repairs to the breakwater.

For reference to reports on survey, see Annual Report of the Chief of Engineers for 1896, page 307.

July 1, 1906, balance unexpended.....	\$943. 66
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	41. 00
July 1, 1907, balance unexpended.....	902. 66

(See Appendix J J 9.)

11. *Harbor of refuge at Grand Marais, Mich.*—Originally the entrance to this harbor was obstructed by a bar having but 9 feet depth of water upon it. The project for its improvement, adopted August 5, 1881, and modified December 21, 1894, has for its object a deep and safe channel into the harbor, making it a harbor of refuge. This object is to be attained by building parallel piers 500 feet apart, projecting into the lake to a depth of 22 feet, and dredging out an 18-foot channel between them, connecting the deep water of the lake with that of the harbor, and by closing up the natural entrance, 5,770 feet in width, by a solid pile dike, driven with a slope toward the waves and strongly braced. The proposed length of each pier was 1,800 feet. The estimated cost of the entire project was \$484,000. The west pier has now reached a length of 1,912 feet, the east pier 1,545 feet, and the pile dike is completed.

This dike was built in 1895–1897 to close the natural entrance, to protect the harbor from storms, and prevent the movement of sand into the harbor. The expected formation of a sand beach along the line of the dike is partially realized, but much of the dike is still exposed to the heavy seas and to damage by ice.

The amount expended on the project up to the close of the fiscal year ending June 30, 1907, not including outstanding liabilities, was \$448,077.29, of which \$92,192 was expended for maintenance.

About 3,600 feet of the pile dike was repaired and strengthened between September 1, 1904, and August 6, 1906, under two contracts, at a total cost (including administration) of nearly \$54,000.

It is hoped that no further work than this will be necessary on the dike, but it is possible that the riprap will settle into the sand bottom by the action of waves and require additional rock.

The last dredging was done in 1904 and gave an average depth of 18½ feet at low-water datum and a least depth of 16 feet (where some lumps were left by the dredge) for a width of 180 feet to 190 feet.

Some shoaling in the entrance channel has occurred since this dredging was done, soundings taken in the spring of 1906 showing a depth of 14 to 16 feet in the central width of 250 feet through the entrance.

Some dredging between the piers will be needed in the next two years.

The usual variation of water level extends from 0 to +1 foot above low-water datum.

In front of the entrance to the harbor the 22-foot curve of depth has advanced lakeward between 400 and 500 feet since the project for improvement was adopted, and this fact will entail some additional expense for pier extension to deep water. This would now require an addition of 360 feet to the west pier and 704 feet to the east pier. This would bring the total cost of these extensions up to \$127,680—about \$44,512 more than the original estimate. It is hoped, however, that the original estimate will finish the west pier and build all that is necessary of the east pier. The west pier is now advanced 344 feet farther into the lake than the east pier.

The sand movement in front of the entrance is generally from the west toward the east, and it is important that the west pier be extended to deep water soon, in order to shut off the encroachment of sand upon the channel from that direction. The extension of the east pier should be built after the completion of the west pier, and it is quite possible that its full extension will not be necessary.

The commerce of this port has increased from 1,910 tons in 1887 to 656 arrivals and clearances, with 90,497 tons of freight, valued at \$691,650, in 1896, and 1,852 arrivals and clearances in 1906, with 103,575 short tons, valued at \$2,508,375.

The total commerce from 1880 to 1906, inclusive, is estimated at 1,336,259 short tons, valued at \$20,497,866.

Effect of project on freight rates: Estimated saving by water transportation as against rail, \$1.79 per ton, amounting to \$185,400 for the lake commerce of 1906. (See p. 590 of this report.) With the original condition of the harbor this shipping could not have been carried on, and the above-mentioned saving in cost of transportation is a result of the project for improvement.

The available balance it is proposed to expend in extending the west pier, and in repairs to piers and dike, and in dredging between the piers.

For reports on examinations and surveys, see Annual Report of the Chief of Engineers for 1906, page 579, where references are given.

July 1, 1906, balance unexpended.....	\$29,188.96
Amount appropriated by river and harbor act approved March 2, 1907.....	30,000.00
	<hr/> 59,188.96
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	21,542.93
	<hr/> 37,646.03
July 1, 1907, balance unexpended.....	<hr/> 45,401.68
Amount (estimated) required for completion of existing project.....	
(See Appendix J J 10.)	

EXAMINATION AND SURVEY OF DULUTH-SUPERIOR HARBOR, MINNESOTA  
AND WISCONSIN, MADE IN COMPLIANCE WITH CONCURRENT RESOLUTION  
OF CONGRESS OF JUNE 20, 1906.

Report dated September 5, 1906, was submitted by a Board of Engineers pursuant to requirement of concurrent resolution of Congress dated June 20, 1906, on *examination and survey of Duluth Harbor, Minnesota, with a view to determining what modifications, if any, should be made in the present plan of improvement.* The report was

transmitted to Congress and printed in House Document No. 82, Fifty-ninth Congress, second session. Plans for improvement at Superior Entry, at an estimated cost of \$1,703,000, and at the Duluth entrance, at an estimated cost of \$10,000, with annual maintenance charge of \$2,500, are presented.

#### IMPROVEMENT OF RIVERS AND HARBORS ON THE NORTHERN AND WESTERN SHORES OF LAKE MICHIGAN.

This district was in the charge of Maj. W. V. Judson, Corps of Engineers. Division engineer, Lieut. Col. W. H. Bixby, Corps of Engineers.

1. *Manistique Harbor, Michigan.*—The original depth at the mouth of the Manistique River was 8 feet. By private enterprise 3,000 linear feet of slab piers had been built and a channel dredged to a depth of 11 feet before any appropriation was made by the Government.

The original project, adopted in 1880, provided for increasing the depth of the channel to 13 feet below datum for a width of 150 feet by dredging. The amount expended on this project was \$3,955.05.

The present project, adopted by the river and harbor act of March 3, 1905, is estimated to cost \$270,000, and provides for pier construction, breakwater extension, and dredging to a depth of 19 feet below datum. (See Annual Report for 1905, p. 525.)

The estimate of cost does not include the acquisition of land and existing structures required in connection with the proposed work, which must be transferred to the United States without expense before the improvement is begun.

The river and harbor act approved March 2, 1907, provides that the appropriation for improvement and maintenance of this harbor is "to be expended by the Secretary of War upon the present project or any modification thereof." A modification of the present project is in preparation, but has not yet been submitted to the Secretary of War for approval.

The amount expended on the work of existing project up to the close of the fiscal year ending June 30, 1907, was \$4,454.14, none of which was applied to maintenance.

The expenditures during the fiscal year have been for general supervision. No result in the way of increased depth and width has been obtained.

A dam across the Manistique River, located about 1 mile from the mouth of the harbor, constitutes the head of navigation.

It is proposed to expend the available balance in the construction of the west pier. The maximum draft which could be carried June 30, 1907, was about 15 feet. The usual mean annual variation of level of water surface is about 1 foot.

The commerce affected by the project is in lumber, coal, and general merchandise. Car ferries call at this harbor during the entire year. The volume of commerce which will be benefited is considerable. The value of the commerce affected is not known.

It is believed that the project will have a material effect in controlling freight rates on bulk commodities, such as coal, grain, and ore, both locally and for transshipment. It is impracticable to estimate the amount of reduction in rates thereby effected.

For references to more extended information and for report on examination and survey see Annual Report for 1904, Part 3, page 2869.

*Commercial statistics for 1906.*—Arrivals of vessels, 79; shipments and receipts, 92,907 net tons.

July 1, 1906, balance unexpended.....	\$22, 614. 55
Amount appropriated by river and harbor act approved March 2, 1907.....	25, 000. 00
	<hr/> 47, 614. 55
June 30, 1907, amount expended during fiscal year, for works of improvement.....	23. 74
July 1, 1907, balance unexpended.....	<hr/> 47, 590. 81
Amount (estimated) required for completion of existing project.....	220, 000. 00
(See Appendix K K 1.)	

2. *Gladstone Harbor, Michigan.*—The harbor of Gladstone is a natural one, and the main channel is from 24 to 42 feet in depth. The portion of this harbor under improvement was obstructed by shoals.

The original project, which is the existing project, was adopted by act of March 3, 1905, and provides for dredging to a depth of 21 feet below datum of so much of the harbor as lies outside of a line drawn perpendicular to the axis of the ore dock through its outer end. Estimated cost, \$14,000. The amount expended on the work up to the close of the fiscal year ending June 30, 1907, was \$7,527.76, of which \$247.17 was applied to maintenance.

The expenditures during the fiscal year have been for general supervision.

The approved project was completed in 1905; since then the expenditures have been for maintenance.

The maximum draft which could be carried June 30, 1907, was about 21 feet. The usual mean annual variation of level of water surface is about 1 foot.

The commerce affected by the project is mostly coal, grain, flour, and general merchandise, and is general in character. The volume of commerce is large; its value is not known.

It is believed that the project has a material effect in controlling freight rates on bulk commodities, such as coal, grain, and ore, both locally and for transshipment. It is impracticable to estimate the amount of reduction in rates thereby effected.

For report on examination and survey, see Annual Report for 1904, Part 3, page 2861.

*Commercial statistics for 1906.*—Arrivals of vessels, 311; shipments and receipts, 527,193 net tons.

July 1, 1906, balance unexpended.....	\$6, 719. 41
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	247. 17
July 1, 1907, balance unexpended.....	<hr/> 6, 472. 24

(See Appendix K K 2.)

3. *Menominee Harbor and River, Michigan and Wisconsin.*—Prior to act of June 13, 1902, the harbor and river constituted two works. By this act they were consolidated.

(a) *Harbor.*—Original depth of channel, about 5 feet; width, 200 feet. The original project, adopted in 1871, provided for two parallel piers, 400 feet apart, extending to the 16-foot contour in Green

Bay, and for a channel 15 feet deep between them, modified as follows: 1874, extending piers to 17-foot contour; 1890, increasing depth to 17 feet; 1899, increasing depth to 20 feet. Amount expended on original and modified projects, \$234,344.77.

(b) *River*.—Original navigable depth, 5 feet. The original project, adopted in 1890, provided for a channel 200 feet wide and 17 feet deep, modified as follows: 1892, width at upper end reduced to 100 feet; 1896, formation of a turning basin 250 feet wide, 600 feet long, 17 feet deep at upper end of channel, and extending channel 425 feet for a width of 75 feet. Amount expended on original and modified projects, \$114,414.15.

(c) *Harbor and river*.—The existing project, adopted by act of Congress approved June 13, 1902, provides for increasing the depth to 20 feet, at an estimated cost of \$60,000.

Under a provision of the act of March 3, 1905, the existing project was modified by omitting therefrom the improvement of all that portion of the Menominee River above and to the westward of Ogden Street Bridge.

The amount expended on the work of existing project up to the close of the fiscal year ending June 30, 1907, was \$51,421.15, of which amount \$13,169.46 was applied for maintenance. Of this amount \$3,372.14 was derived from miscellaneous sources.

The existing project, as modified, was completed in 1903. Since then the expenditures have been for maintenance.

The expenditures during the fiscal year have been for renewal of the harbor piers above the water line. No result in the way of increased depth and width has been obtained.

The maximum draft that could be carried June 30, 1907, over the shoalest part of the locality under improvement was about 19 feet. The mean annual variation of level of water surface is about 1 foot.

It is proposed to expend the available balance in renewal of piers above the water line and in dredging.

The Menominee River is navigable for a distance of about 2 miles from its mouth.

The volume of commerce, while large, is not increasing. Its value is not known.

It is believed that the project has a material effect in controlling freight rates on bulk commodities, such as coal, grain, and lumber, both locally and for transshipment. It is impracticable to estimate the amount of reduction in rates thereby effected.

For references to more extended information, maps, and reports on examinations and surveys, see Annual Report for 1904, page 519.

*Commercial statistics for 1906*.—Arrivals of vessels, 219; shipments and receipts, 120,158 net tons.

July 1, 1906, balance unexpended	\$6,201.16
Miscellaneous receipts	1,845.14
Amount appropriated by river and harbor act approved March 2, 1907	5,000.00
	13,046.30
June 30, 1907, amount expended during fiscal year, for maintenance of improvement	5,292.20
July 1, 1907, balance unexpended	7,754.10

(See Appendix K K 3.)

4. *Oconto Harbor, Wisconsin.*—The original depth at the mouth of the river, about 3 feet, was increased by private enterprise to 4 feet before work was begun by the United States.

The original project, adopted in 1882, provided for extending the parallel slab piers built by the city of Oconto to the 11-foot contour in Green Bay and for a channel 100 feet wide and 9 feet deep extending up the Oconto River a distance of about 2 miles, at an estimated cost of \$150,000; modified in 1897 by abandoning the upper 3,800 feet of the channel; estimated cost of modified project, \$115,610.

The amount expended to June 30, 1907, was \$92,579.65, of which \$8,010.18 was applied to maintenance.

The expenditures during the fiscal year have been for general supervision.

The 9-foot channel was practically completed in 1899.

The maximum draft that could be carried June 30, 1902, was about 7.5 feet. No soundings have been taken since then. For 1,000 feet above the westerly end of the Government improvement the Oconto River has a navigable depth of about 3 feet.

Mean annual variation in level of water surface is about 1 foot.

The commerce benefited by the improvement is of a purely local character and very small in volume.

It is believed that the project has no material effect in controlling freight rates.

For references to more extended information, maps, and reports on examinations and surveys, see Annual Reports for 1904, page 520, and 1906, page 599.

*Commercial statistics for 1906.*—Shipments and receipts by all ways of transportation, 529,256 net tons; shipments and receipts by way of the harbor only, 5,725 net tons.

July 1, 1906, balance unexpended.....	\$3, 645. 35
June 30, 1907, amount expended during fiscal year, for maintenance of improvement .....	225. 00

July 1, 1907, balance unexpended.....	3, 420. 35
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(See Appendix K K 4.)

5. *Green Bay Harbor, Wisconsin.*—This work consists of two improved channels—first, from the mouth of Fox River northerly to the 21-foot contour in Green Bay; second, Fox River below Depere to the southerly limits of the city of Green Bay. The intervening pool in Fox River, connecting these channels, has a natural depth of from 25 to 40 feet and requires no improvement. The outer channel was originally circuitous and narrow, with an available depth of 11 feet. The original navigable depth of the inner channel was also 11 feet.

The original project for outer channel, adopted in 1866, provided for dredging a channel 200 feet wide, 13 feet deep, and 8,800 feet long, and for revetting about 650 feet of same at Grassy Island, modified as follows: 1872, straightening channel and increasing depth to 14 feet; 1874, depth 15 feet, length 11,600 feet; 1892, depth 17 feet, length 16,500 feet; 1897, increasing width at entrance to 500 feet.

The original project for inner channel, adopted in 1892, provided for dredging a channel 150 feet wide and 13 feet deep, modified as follows: 1896, increasing depth to 17 feet.

These channels were completed by the expenditure of \$405,945.18.

The existing project, adopted by Congress by act approved June 13, 1902, provides for increasing the depth of the outer channel to 20 feet, at an estimated cost of \$105,600. It also provides for maintenance of existing works.

The amount expended on the work of existing project up to the close of the fiscal year ending June 30, 1907, was \$114,590.81, of which amount \$12,244.09 was applied to maintenance.

The expenditures during the fiscal year have been for repairs to revetments at Grassy Island and for general supervision.

The approved project was completed in 1903. Since then all expenditures have been for maintenance.

The maximum draft that could be carried June 30, 1907, was about 18 feet in the outer channel and 14.5 feet in the inner channel.

The mean annual variation in level of water surface is about 1 foot.

Connecting with the upper end of the inner channel at Depere, Wis., Fox River is navigable by canals and slack-water navigation to Portage, Wis., a distance of 156 miles.

The commerce of Green Bay is large and of a general character. Its value is not known.

It is believed that the project has a material effect in controlling freight rates on bulk commodities, such as coal, grain, and lumber, both locally and for transshipment.

It is proposed to apply the available balance in maintenance of channel and existing works.

For references to more extended information, maps, and reports on examinations and surveys see Annual Report for 1904, page 521.

*Commercial statistics for 1906.*—Arrivals of vessels, 1,415; shipments and receipts by water, 957,479 net tons.

July 1, 1906, balance unexpended.....	\$10, 107. 39
Amount appropriated by river and harbor act approved March 2, 1907.....	5, 000. 00
	<hr/>
	15, 107. 39
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	6, 512. 49
	<hr/>
July 1, 1907, balance unexpended.....	8, 594. 90
(See Appendix K K 5.)	

6. *Sturgeon Bay and Lake Michigan Ship Canal, Wisconsin, and harbor of refuge connected therewith.*—Prior to act of June 13, 1902, the canal and harbor constituted two works. By this act they were consolidated.

(a) *Canal.*—In its natural condition Lake Michigan was separated from Sturgeon Bay, an arm of Green Bay, by a neck of land about 1½ miles wide, having a maximum elevation above the lake level of about 28 feet. The Sturgeon Bay and Lake Michigan Ship Canal and Harbor Company, from 1872 to 1881, constructed across this neck a canal, without locks or gates, 7,200 feet long, 100 feet wide at water surface, and 14 feet deep, and in continuation of the canal dredged a channel in Sturgeon Bay 6,100 feet long, of about same dimensions as the canal. Of the 14,000 linear feet of canal banks, 8,437 feet was provided with pile revetments. The United States assumed possession of the canal April 25, 1893.

The original project, adopted in 1874, provided for building 6,000 linear feet of revetment, width between new revetments to be 160 feet, for building 2,000 linear feet of fender piling, and for a channel 15 feet deep; modified as follows: 1876, provided for a width of 250 feet between revetments for the westerly 1,000 feet of the canal, and for increasing width between revetments, whenever rebuilt, to 160 feet. The original project as modified was completed during the fiscal year ending June 30, 1903.

(b) *Harbor*.—Before the construction of this harbor was undertaken the Lake Michigan entrance to the Sturgeon Bay and Lake Michigan Ship Canal was entirely unprotected from storms from northeast to southwest.

The original project, adopted in 1873, provided for the construction of converging piers 850 feet apart at the shore line, and 250 feet apart at outer end, inclosing an area of about 10 acres, which was to be dredged to the requirements of navigation at that time; modified as follows: 1879, provided for sheet piling the pile piers; 1880, provided for extending each pier 150 feet by detached cribs, thereby increasing width of entrance to 335 feet, and dredging to a depth of 17 feet. The original project as modified was completed in 1884.

The amount expended on the foregoing projects is \$349,119.26.

(c) *Canal and harbor*.—The existing project adopted by act of Congress approved June 13, 1902, provides for maintenance and for increasing the depth of channel to 21 feet from Lake Michigan to Sturgeon Bay; estimated cost, \$222,000. The river and harbor act approved March 2, 1907, authorizes dredging in the vicinity of Hills Point.

The amount expended on existing project up to the close of the fiscal year ending June 30, 1907, is \$227,228.88, of which \$18,092.86 was applied to maintenance. Of this amount \$11,839.75 was derived from miscellaneous sources.

The expenditures during the fiscal year have been principally for dredging in the vicinity of Hills Point, and have resulted in increasing the width of 21-foot channel at that locality from about 120 feet to about 300 feet.

The existing project is completed with the exception of dredging about 500 feet of channel in the vicinity of the bridge. The funds available are sufficient for completion of project.

The maximum draft that could be carried June 30, 1907, between Lake Michigan and the bridge was about 19 feet, but on account of shoal water in the draws of the bridge the maximum draft that could be carried between Lake Michigan and Green Bay was about 15 feet.

Mean annual variation in level of water surface is about 1 foot.

It is believed that the project has a material effect in controlling freight rates on bulk commodities, such as coal, grain, and lumber. It is impracticable to estimate the amount of reduction in rates thereby effected.

For references to more extended information, maps, and reports on examinations and surveys see Annual Report for 1904, page 523.

*Commercial statistics for 1906*.—Number of vessels passing through canal, 2,366; tonnage, 1,478,282; estimated value of cargoes, \$20,340,763.40; number of vessels seeking shelter, 120; tonnage,



48,899; number of passengers passing through canal, 17,392; decrease in value of cargo in 1906, compared with 1905, \$693,706.

July 1, 1906, balance unexpended..... \$62, 857. 70  
 June 30, 1907, amount expended during fiscal year:

For works of improvement.....	\$2, 216. 83	
For maintenance of improvement.....	2, 526. 61	
		4, 743. 44

July 1, 1907, balance unexpended..... 58, 114. 26

(See Appendix K K 6.)

7. *Operating and care of Sturgeon Bay and Lake Michigan Ship Canal, Wisconsin.*—Under an allotment from the indefinite appropriation of July 5, 1884, for operating and care of canals and other works of navigation, there was expended during the fiscal year ending June 30, 1907, \$23,909.19.

Repairs were made to the revetments at various places where needed and to the buildings and plant pertaining to the canal. The premises in the vicinity of the office and watch houses were graded and otherwise improved and the canal operated and cared for in accordance with the approved project. A new office building was built and the house occupied by the assistant superintendent was enlarged.

Navigation through the canal opened April 10, 1906, closed by ice January 11, 1907, and resumed April 1, 1907.

For commercial statistics, see report upon improvement of Sturgeon Bay and Lake Michigan Ship Canal and harbor of refuge connected therewith.

(See Appendix K K 7.)

8. *Algoma Harbor, Wisconsin.*—Previous to the improvement of this harbor the depth of water at the mouth of the Ahnapee (or Wolf) River was only 3 feet and the present harbor was not available for purposes of commerce.

The original project adopted in 1875 provided for the formation of a small artificial harbor, connected with the lake by a channel 100 feet wide and 13 feet deep, by pier construction, dredging, and rock removal, modified as follows: 1884, width of entrance increased to 200 feet by offset in each pier, main and detached piers to be connected by guide piling; March 3, 1899, provided for extending the 13-foot channel, for a width of 50 feet, a distance of 800 feet by rock removal and dredging, at an estimated cost of \$19,266.

The amount expended on this project and its modifications to June 30, 1907, is \$201,681.46, of which \$8,687.96 was for maintenance.

The existing project, adopted by Congress by act approved March 2, 1907, provides for the construction of an outer harbor, with a depth of 16 feet of water; estimated cost, \$140,000, of which \$100,000 is yet to be appropriated under continuing-contract authorization.

The amount expended on the work of existing project up to the close of the fiscal year ending June 30, 1907, was \$934.25. No result in the way of increased depth has yet been obtained, the expenditures having been for survey and preparation of plan for outer harbor.

The maximum draft that could be carried to the Goodrich dock June 30, 1907, was about 12 feet. The mean annual variation in level of water surface is about 1 foot.

Ahnapee River is navigable for a distance of about 2 miles from its mouth for crafts drawing 4 feet, but there are no vessels plying on it.

The volume of commerce benefited is small and of a local character. It is believed that the project has no material effect in controlling freight rates.

It is proposed to expend the amount estimated as a profitable expenditure in fiscal year ending June 30, 1909, for completion of existing project.

For references to more extended information, maps, and report on examination and survey, see Annual Report for 1904, page 524.

*Commercial statistics for 1906.*—Arrivals of vessels, 644; shipments and receipts by all ways of transportation, 142,667 tons, about two-thirds of which is by way of the harbor.

July 1, 1906, balance unexpended.....	\$4,960.04
Amount appropriated by river and harbor act approved March 2, 1907..	43,000.00

47,960.04

June 30, 1907, amount expended during fiscal year:

For works of improvement.....	\$934.25	
For maintenance of improvement.....	421.50	
		1,355.75

July 1, 1907, balance unexpended.....	46,604.29
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July 1, 1907, outstanding liabilities .....	512.58
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July 1, 1907, balance available.....	46,091.71
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Amount (estimated) required for completion of existing project....	100,000.00
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{	Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907.....	100,000.00
	Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

(See Appendix K K 8.)

9. *Kewaunee Harbor, Wisconsin.*—The original entrance to the Kewaunee River was not more than 20 feet wide, with a depth of about 3 feet at its shoalest point, and was obstructed by submerged bowlders. The present harbor was therefore not available for purposes of commerce.

The original project for its improvement adopted in 1881, which is the existing project, provided for an artificial entrance channel 15 feet deep, located about 2,000 feet south of the river mouth, protected by two parallel piers 200 feet apart, and extending from the shore to the 19-foot contour in the lake. Estimated cost, \$200,000. The project was completed in 1898 at a cost of about \$150,000.

The amount expended up to June 30, 1907, was \$171,750.97, of which amount \$21,750.97 was for maintenance. Of this amount, \$417.44 was derived from miscellaneous sources.

The expenditures during the fiscal year have been for maintenance and general supervision.

The maximum draft that could be carried June 30, 1907, was about 16 feet. The mean annual variation in level of water surface is about 1 foot.

Connecting with the westerly end of the improved channel Kewaunee River has a navigable depth of 4 feet for a distance of about  $6\frac{1}{2}$  miles, but there is no regular commerce on the river.

The additional work proposed is for maintenance of piers and channel.

The volume of commerce is quite large and is of a general character. A line of car-ferry steamers calls at this harbor. The value of the water-borne commerce is stated by the mayor of Kewaunee to be as follows: Shipments, \$5,598,000; receipts, \$6,405,000; total, \$12,003,000. The reliability of these figures is uncertain.

It is believed that the project has a material effect in controlling freight rates on bulk commodities, such as coal, grain, etc., both locally and for transshipment. It is impracticable to estimate the amount of reduction in rates thereby effected.

For references to more extended information, maps, and reports on examination and survey, see Annual Report for 1904, page 525.

*Commercial statistics for 1906.*—Arrivals of vessels, 446; shipments and receipts, 139,297 net tons.

July 1, 1906, balance unexpended.....	\$2, 526. 69
Miscellaneous receipts .....	365. 25
Amount appropriated by river and harbor act approved March 2, 1907.....	5, 000. 00
	<hr/>
	7, 891. 94
June 30, 1907, amount expended during fiscal year, for maintenance of improvement .....	1, 425. 47
	<hr/>
July 1, 1907, balance unexpended.....	6, 466. 47
(See Appendix K K 9.)	

10. *Two Rivers Harbor, Wisconsin.*—The original depth of the entrance to Twin rivers was from 3 to 4 feet and the present harbor was not available for purposes of commerce.

The original project adopted March 3, 1871, provided for the formation of a channel of navigable width and 13 feet deep, connecting Twin rivers with Lake Michigan by building parallel piers extending to the 19-foot contour and dredging between them, at an estimated cost of \$265,588.80, modified in 1897, by terminating the piers at the 14-foot contour.

The total amount expended on original and modified project was \$247,613.35.

The existing project, adopted March 2, 1907, is a modification of plan "A," printed in House Document No. 730, Fifty-ninth Congress, first session, and provides for increasing the depth of channel to 16 feet and for the construction of a stilling basin on the north side of harbor. The sum of \$90,000 was appropriated for the purpose.

The amount expended on the work of existing project up to the close of the fiscal year ending June 30, 1907, was \$2,530.29, all of which was applied to maintenance. No result in the way of increased depth has yet been obtained.

The expenditures during the fiscal year were for maintenance, consisting of repairs to the pile revetments along the harbor piers and the restoration of the channel by dredging.

The maximum draft that could be carried June 30, 1907, was about 13 feet. The mean annual variation in level of water surface is about 1 foot.

East and West Twin rivers have a navigable depth of 7 feet for a distance of about 3 miles and 7 miles, respectively, from the harbor piers. There is no regular commerce on these rivers. For many years they have been used by rowboats and for floating saw logs.

The volume of commerce of this harbor is small and of a local character. Its value is not known.

It is believed that the project has a small effect in controlling freight rates on coal for local consumption, but the amount of reduction in rates is unknown.

For references to more extended information, maps, and reports on examinations and surveys, see Annual Reports for 1904, page 526, and for 1906, pages 599 and 645.

*Commercial statistics for 1906.*—Arrivals of vessels, 341; receipts, 35,425 net tons.

July 1, 1906, balance unexpended.....	\$1, 730. 82
Amount appropriated by river and harbor act approved March 2, 1907.....	90, 000. 00

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91, 730. 82

June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	2, 774. 46
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July 1, 1907, balance unexpended.....	88, 956. 36
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July 1, 1907, outstanding liabilities.....	1, 875. 00
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July 1, 1907, balance available.....	87, 081. 36
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(See Appendix K K 10.)

11. *Manitowoc Harbor, Wisconsin.*—The original depth of water at the mouth of the Manitowoc River was about 4 feet at the shoalest point, and the existing harbor was not available for purposes of commerce.

The original project, adopted in 1854, provided for building parallel piers 220 feet apart and dredging between them to obtain a channel 12 feet in depth connecting Manitowoc River with Lake Michigan, modified as follows: 1881, provided for extending piers to 191-foot contour and increasing depth to 19 feet at entrance and 15 feet at the shore line; 1890, provided for an exterior breakwater 400 feet long, 24 feet wide; 1896, provided for increasing depth of channel to 20 feet and extending south pier 500 feet; 1902, provided for extending the breakwater 400 feet.

The original project as subsequently modified was completed in 1903. The total amount expended thereon, including maintenance up to the time of adoption of present project, is \$454,666.79.

The existing project, adopted by Congress March 2, 1907, provides for maintenance of 20-foot channel and for the reconstruction of the harbor by the removal of outer 500 feet of existing breakwater and nearly all of the old parallel piers and by construction of new breakwaters and piers in accordance with report submitted in House Document No. 62, Fifty-ninth Congress, first session, as modified by Board of Engineers for Rivers and Harbors: estimated cost, \$376,000, of which \$276,000 is yet to be appropriated under continuing-contract authorization.

The amount expended under the existing project up to the close of the fiscal year ending June 30, 1907, was \$3,605.20, of which \$428.83 was for maintenance.

The expenditures during the fiscal year have been for repairs to breakwater and south pier, for timber to be used in breakwater and pier construction under existing contracts, and for general supervision.

It is proposed to expend the amount estimated as a profitable expenditure in fiscal year ending June 30, 1909, for completion of existing project.

The maximum draft that could be carried June 30, 1907, was about 20 feet. The usual mean annual variation of level of water surface is about 1 foot.

Connecting with the western end of the Government improvement, Manitowoc River is navigable for a distance of about 1.8 miles.

The volume of commerce is very large and of a general character. Two lines of car-ferry steamers call at this harbor daily throughout the entire year.

The city and one of the terminal railroads have recently begun extensive improvements of the inner harbor.

It is believed that the project has a very material effect in controlling freight rates, both locally and for transshipment; it is impracticable to estimate the amount of reduction in rates thereby effected.

For references for more extended information, maps, and reports on examinations and surveys see Annual Reports for 1904, page 526, and 1906, page 645.

*Commercial statistics for 1906.*—Arrivals of vessels, 1,792; shipments and receipts, 1,202,170 net tons.

July 1, 1906, balance unexpended.....	\$109, 755. 80
Amount appropriated by river and harbor act approved March 2, 1907.....	100, 000. 00

209, 755. 80

June 30, 1907, amount expended during fiscal year:

For works of improvement.....	\$3, 605. 20
For maintenance of improvement.....	5, 609. 87

9, 215. 07

July 1, 1907, balance unexpended.....	200, 540. 73
July 1, 1907, outstanding liabilities.....	190. 00

July 1, 1907, balance available.....	200, 350. 73
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July 1, 1907, amount covered by uncompleted contracts.....	304, 275. 72
Amount (estimated) required for completion of existing project.....	276, 000. 00

{	Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907.....	276, 000. 00
	Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

(See Appendix K K 11.)

12. *Sheboygan Harbor, Wisconsin.*—The depth of water over the bar at the mouth of the Sheboygan River originally did not exceed 7 feet, and the present harbor was not available for purposes of commerce.

The original project, adopted in 1866, provided for extending the piers built by the city and county of Sheboygan to the 13-foot contour and dredging between them to a depth of 13 feet; modified as follows: 1873, for a deeper channel and pier extension; 1881, for extend-

ing piers to 21-foot contour and a depth of 19 feet at entrance diminishing to 15 feet at shore line; 1894, for increasing width between piers and for a channel 19 feet deep; 1899, for a breakwater 700 feet long; 1902, for extending both piers and increasing depth of channel to 21 feet.

The original project as modified was completed in 1904 with the exception of 100 feet of breakwater. The total amount expended thereon, including maintenance up to the time of adoption of present project, is \$575,099.44.

The existing project, adopted by Congress March 2, 1907, provides for maintenance of 21-foot channel and works incident thereto, for extension of north breakwater, for a south breakwater, and for subsequent necessary extensions to each breakwater in general accordance with type plan as set forth in report submitted in House Document No. 62, Fifty-ninth Congress, first session. No estimate of cost has been prepared.

The amount expended under the existing project up to the close of the fiscal year ending June 30, 1907, was \$1,813.49, of which \$172.39 was for maintenance.

The expenditures during the fiscal year have been for repairs to breakwater, for dredging for restoration of channel, and for timber to be used in breakwater construction under existing contract.

The maximum draft that could be carried June 30, 1907, was about 20 feet. The usual mean annual variation of level of water surface is about 1 foot.

Connecting with the westerly end of the Government improvement, Sheboygan River is navigable for a distance of  $1\frac{1}{2}$  miles.

The commerce of Sheboygan is quite large and of a general character. Its value is unknown.

It is believed that the project has an economic effect in the handling of bulk commodities, such as coal, grain, etc., both locally and for transshipment. It is impracticable to estimate the amount of reduction in rates thereby effected.

For references for more extended information, maps, and reports on examinations and surveys, see Annual Reports for 1904, page 527, and 1906, page 645.

*Commercial statistics for 1906.*—Arrivals of vessels, 823; shipments and receipts, 542,337 tons.

July 1, 1906, balance unexpended.....	\$12, 963. 29
August 23, 1906, allotted from emergencies in river and harbor works, "restoring channel depths".....	3, 597. 36
Miscellaneous receipts .....	59. 71
Amount appropriated by river and harbor act approved March 2, 1907.....	40, 000. 00

56, 620. 36

June 30, 1907, amount expended during fiscal year:

For works of improvement.....	\$1, 813. 49
For maintenance of improvement.....	4, 900. 34
	6, 713. 83

July 1, 1907, balance unexpended..... 49, 906. 53

July 1, 1907, amount covered by uncompleted contracts..... 25, 985. 03

(See Appendix K K 12.)



13. *Port Washington Harbor, Wisconsin.*—The natural channel at the mouth of the Sauk River was narrow, and at the shoalest point had a depth of 1 foot. The present harbor was not available for purposes of commerce.

The original project, adopted in 1869, provided for a channel between parallel piers, 150 feet apart, extending from the shore to the 11-foot contour, and for a basin 600 feet long by 200 feet wide, inside the shore line, modified as follows: June 7, 1877, extending piers to 15-foot contour and a second basin to the northward and nearly at right angles to the first basin, the depth in channel and basins to be 13 feet. The original project, as modified, is the existing project. Estimated cost, \$181,527.17.

The existing project was completed in 1895 at a cost of \$184,848.39.

The amount expended up to June 30, 1907, was \$201,499.36, of which \$1,871.30 was for maintenance. Of this amount \$68.25 was derived from miscellaneous sources.

The expenditures during the fiscal year have been for maintenance of piers and for general supervision.

The maximum draft that could be carried June 30, 1907, was about 12½ feet. The usual mean annual variation of levels of water surface is about 1 foot.

The volume of commerce benefited is small, and is of a local character. Its value in shipments is stated by the mayor of Port Washington to be \$1,180,000.

It is believed that the project has no material effect in controlling freight rates, except on coal for local consumption.

For references to more extended information and for reports on examinations and surveys see Annual Report for 1904, pages 528 and 2899.

*Commercial statistics for 1906.*—Arrivals of vessels (1905), 266; shipments and receipts, 49,454 net tons.

July 1, 1906, balance unexpended.....	\$4, 234. 05
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	765. 16

July 1, 1907, balance unexpended.....	3, 468. 89
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(See Appendix K K 13.)

14. *Milwaukee Harbor, Wisconsin, including harbor of refuge.*—Milwaukee Harbor and the harbor of refuge, which were originally separate works, were consolidated by the act of June 13, 1902.

The original depth of water at the mouth of the Milwaukee River was not more than 4½ feet, and the present harbor was not available for purposes of commerce; but the situation of the entrance, in a bay protected from storms, except those from northeast to southeast, and the 7 miles of interior river easily susceptible of improvement, have made the problem of obtaining a harbor a relatively inexpensive one.

The original project for the improvement of Milwaukee Harbor was adopted in 1845-46, and provided for dredging the original river mouth and protecting the entrance by parallel piers, modified as follows: 1852, provided for the formation of a channel 260 feet wide and 13 feet deep, located 3,000 feet to the northward of

original mouth of the Milwaukee River, by dredging across the overlapping point and protecting the channel by parallel piers, each 1,120 feet long; 1868, provided for extending each pier 600 feet; 1899, provided for deepening the channel to 21 feet; 1902, provided for concrete superstructure on 1,050 feet of the north pier; 1905, provided for completing concrete superstructure on north pier, a distance of 600 feet.

The original project for the harbor of refuge was adopted in 1881 and provided for a breakwater 7,650 feet long, including an opening therein of 400 feet; the acts of 1902 and 1905 provided for concrete superstructure on 3,450 feet of the northern end of the breakwater.

These original projects as modified were completed in 1906. The total amount expended thereon, including maintenance up to the time of adoption of the present project, is \$1,727,426.33.

The act approved March 2, 1907, provides for maintenance of 21-foot channel, rebuilding south pier, building 3,800 feet of concrete superstructure on breakwater, and modifies the project by providing for an extension of the breakwater 1,000 feet. Contracts were authorized for completion of the work in the sum of \$392,000, yet to be appropriated.

The amount expended under the existing project up to the close of the fiscal year ending June 30, 1907, was \$6,310.10, of which \$5,865.59 was for maintenance.

The expenditures during the fiscal year have been for completion of the original projects as modified; for minor repairs to south pier; for fir timber stored at Kewaunee, Wis.; for fir timber to be used in breakwater extension, and for general supervision and inspection.

It is proposed to expend the amount estimated as a profitable expenditure in fiscal year ending June 30, 1909, for completion of existing project.

The maximum draft that could be carried June 30, 1907, was 21 feet. The mean annual variation of level of water surface is about 1 foot.

Milwaukee stands among the leading lake ports in the extent and value of its water-borne commerce. It is the leading port (if Duluth and Superior be separately counted) for the distribution of coal from Ohio ports to the West and Northwest. By means of car ferries, which ply both winter and summer, Milwaukee is connected with several railway systems terminating on the east shore of Lake Michigan. The total freight movement by way of the harbor aggregated about 6,200,000 tons for the calendar year 1906.

By reason of its excellent harbor the manufacturers and distributors of Milwaukee enjoy superior shipping facilities and low freight rates, especially to and from eastern points. Many bulky articles, such as coal, salt, sugar, etc., are transhipped from water to rail at Milwaukee. The favorable effect of the harbor upon commerce is by no means local.

For references to more extended information and for reports on examinations and surveys see Annual Report for 1904, pages 529 and 530.

*Commercial statistics for 1906.*—Arrivals of vessels, 5,875; shipments and receipts, 6,204,024 tons.



July 1, 1906, balance unexpended.....	\$121, 668. 87
Amount appropriated by river and harbor act approved March 2, 1907.....	200, 000. 00
	<hr/> 321, 668. 87
June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$444. 51
For maintenance of improvement.....	86, 836. 12
	<hr/> 87, 280. 63
July 1, 1907, balance unexpended.....	234, 388. 24
July 1, 1907, outstanding liabilities.....	48. 30
	<hr/> 234, 339. 94
July 1, 1907, amount covered by uncompleted contracts.....	434, 320. 40
Amount (estimated) required for completion of existing project.....	392, 000. 00
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{ Amount that can be profitably expended in fiscal year ending	
June 30, 1909, for works of improvement, in addition to the	
balance unexpended July 1, 1907.....	392, 000. 00
Submitted in compliance with requirements of sundry civil act of	
June 4, 1897.	

(See Appendix K K 14.)

15. *Milwaukee (inner) Harbor, Wisconsin.*—The original condition of the rivers comprised in the inner harbor of Milwaukee is not definitely known. These rivers have been dredged, and a depth of about 21 feet below datum maintained therein, by the city of Milwaukee.

The original project, which is the existing project, was adopted by act of March 3, 1905, and provides for improving Menominee, Milwaukee, and Kinnickinnick rivers, which constitute the inner harbor of Milwaukee. This project provides for the excavation of four turning basins—one in the Menominee and three in the Kinnickinnick; the excavation of a channel 100 feet wide from the turning basin in Menominee River to its mouth and 150 feet wide thence to the harbor entrance; the excavation of a channel 100 to 150 feet wide from the mouth of the Kinnickinnick to the uppermost turning basin in that river, all channels to be 21 feet deep. The estimated cost of this improvement is \$318,581. The project does not contemplate any maintenance work after the channels and basins have been provided, such work to be left to local interests, and was recommended only on condition that all land needed for turning basins and for widening and straightening the rivers shall be donated to the United States free of cost, that the city of Milwaukee shall revet or dock all turning basins and connecting channels wherever necessary, and that the city bridge over Kinnickinnick River, and the two railway bridges immediately above said bridge, shall be altered or rebuilt in such wise as to permit the passage of the largest vessels. The act in adopting the project provided that no part of the appropriation therein made shall be expended for the purpose named unless the Secretary of War shall have satisfactory assurance that the city of Milwaukee will comply with the conditions imposed upon said municipality as set forth and contained in said project.

By act approved June 30, 1906, Congress authorized the Secretary of War, in his discretion, to modify this project by omitting the turning basin at the head of navigation in the Kinnickinnick River.

The work is to be done under continuing contract.

There has been no expenditure under the existing project, expenditures being contingent upon the conditions mentioned, which have not yet been fulfilled by the city of Milwaukee.

The maximum draft which could be carried June 30, 1907, was about 20 feet. The usual mean annual variation of water surface is about 1 foot. The rivers are actually navigable as follows: Milwaukee River, about  $2\frac{3}{4}$  miles; Menominee River, about 2 miles; Kinnickinnick River, about  $2\frac{1}{4}$  miles.

The commerce of Milwaukee has already been described in the report relating to Milwaukee Harbor.

It is believed that the project will have a material effect in controlling freight rates on bulk commodities, such as coal, grain, and ore, both locally and for transshipment. It is impracticable to estimate the amount of reduction in rates thereby effected.

For report on examination and survey see Annual Report for 1904, Part 3, page 2887.

July 1, 1906, balance unexpended.....	\$100,000.00
July 1, 1907, balance unexpended.....	100,000.00

Amount (estimated) required for completion of existing project..	218,581.00
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(See Appendix K K 15.)

16. *Racine Harbor, Wisconsin.*—The entrance to this harbor at the mouth of Root River originally varied in depth from absolute closure after storms to about 7 feet, and the present harbor was not available for purposes of commerce.

The original project, adopted in 1842–43, provided for a channel 13 feet deep between parallel piers 160 feet apart, modified as follows: 1866, provided for increasing depth to 16 feet and for extension of piers; 1889, provided for increasing depth to 17 feet and for further extension of piers; 1899, provided for widening channel and increasing depth to 21 feet, for extending the south pier, and for a breakwater 600 feet long; 1902, provided for a change in the location and direction of the breakwater.

The original project as modified was completed in 1905. The total amount expended thereon, including maintenance up to the time of adoption of present project, is \$507,141.72.

The existing project, adopted by Congress March 2, 1907, provides for maintenance of 21-foot channel and works incident thereto, for extension of north breakwater, for a south breakwater, and for subsequent necessary extensions to each breakwater, in general accordance with type plan as set forth in report submitted in House Document No. 62, Fifty-ninth Congress, first session. No estimate of cost has been prepared.

The total amount expended on the work of existing project up to the close of the fiscal year ending June 30, 1907, is \$4,859.13. Of this amount, \$4,759.13 was for maintenance.

The expenditures during the fiscal year have been for maintenance of channel and existing works.

The maximum draft that could be carried June 30, 1907, was about 18 feet. The usual mean annual variation of level of water surface is about 1 foot.

Connecting with the western terminus of the Government improvement, Root River is navigable for a distance of about nine-tenths of a mile.

The volume of commerce is quite large and is general in character. Its value is not known.

It is believed that the project serves a useful economic purpose in connection with the handling of bulk commodities, such as coal, both locally and for transshipment, and that freight rates on locally manufactured articles and the raw materials required therefor are reduced by the competing rail and water routes.

For references for more extended information and reports on examinations and surveys, see Annual Reports for 1904, page 531, and 1906, page 645.

*Commercial statistics for 1906.*—Arrivals of vessels, 1,816; shipments and receipts, 162,247 net tons.

July 1, 1906, balance unexpended.....	\$9,357.26
Amount appropriated by river and harbor act approved March 2, 1907.....	50,000.00
	<hr/> 59,357.26

June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$100.00
For maintenance of improvement.....	10,173.64
	<hr/> 10,273.64

July 1, 1907, balance unexpended.....	49,083.62
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July 1, 1907, amount covered by uncompleted contracts.....	9,078.32
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(See Appendix K K 16.)

17. *Kenosha Harbor, Wisconsin.*—The original depth of water at the mouth of Pike Creek varied from nothing to 4 feet, and the present harbor was not available for purposes of commerce.

The original project, adopted in 1852, provided for a channel 13 feet deep between parallel piers 150 feet apart, modified as follows: 1866, provided for a navigable channel 16 feet deep; 1889, provided for extending north pier 300 feet and south pier 600 feet, and for channel 16 feet deep; 1890, provided for dredging in "The Basin;" 1899, provided for extending the south pier, increasing the width between piers to 250 feet by rebuilding the north pier, building 600 feet of breakwater, and increasing the depth in channel and basin to 21 feet and 20 feet, respectively; 1902, provided for extending the breakwater 100 feet shoreward.

The original project as modified was completed in 1900, with the exception of 100 feet extension to breakwater. The total amount expended thereon, including maintenance up to the time of adoption of present project, is \$475,815.37.

The existing project, adopted by Congress March 2, 1907, provides for maintenance of 21-foot entrance channel, 20-foot basin, and existing works, and for an extension of 200 feet to the landward end of the breakwater, for which \$22,000 was appropriated.

The total amount expended on the work of existing project up to the close of the fiscal year ending June 30, 1907, is \$557.93. Of this sum, \$457.93 was for maintenance.

The expenditures during the fiscal year have been for dredging for restoration of the channel and for general supervision and inspection.

The maximum draft that could be carried over the bar at the harbor entrance June 30, 1907, was about 18 feet. The usual mean annual variation of water surface is about 1 foot.

Connecting with the western terminus of the Government improvement, Pike Creek is navigable for a distance of about 2,500 feet.

The volume of commerce is not large and is chiefly of a local character. Its value is not known.

It is believed that the project has an effect in controlling freight rates on locally manufactured articles and coal for local consumption. It is impracticable to estimate the amount of reduction in rates thereby effected.

For references to more extended information and for reports on examinations and surveys, see Annual Reports for 1904, page 532, and 1906, page 645.

*Commercial statistics for 1906.*—Arrivals of vessels, 344; shipments and receipts, 55,812 net tons.

July 1, 1906, balance unexpended.....	\$20,522.53
Amount appropriated by river and harbor act approved March 2, 1907.....	22,000.00
	<hr/> 42,522.53

June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$100.00
For maintenance of improvement.....	2,330.71
	<hr/> 2,430.71

July 1, 1907, balance unexpended.....	40,091.82
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July 1, 1907, amount covered by uncompleted contracts.....	9,763.00
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(See Appendix K K 17.)

18. *Waukegan Harbor, Illinois.*—Originally there was no navigable channel or natural harbor at this place.

The original project was adopted in 1880 and provided for an artificial harbor of sufficient capacity for local trade by inclosing an area with pile piers, the entrance channel and inclosed area to be dredged to 13 feet.

The amount expended on original project prior to commencement of operations under present project was \$218,944.41.

The existing project, adopted by act of June 13, 1902, provides for extending both harbor piers, building a breakwater, and increasing depth of channel to 20 feet; estimated cost, \$345,000, all of which has been appropriated.

This project was completed in 1904, since which the expenditures have been for maintenance.

The total amount expended in the work of existing project up to the close of the fiscal year ending June 30, 1907, is \$358,468.58; of this sum \$48,129.19 was for maintenance, of which amount \$72.93 was derived from miscellaneous sources.

The expenditures during the fiscal year have been for rebuilding superstructure and pile piers and dredging for restoration and maintenance of channel.

The maximum draft which could be carried June 30, 1907, was about 19 feet. The usual mean annual variation of water level is about 1 foot.

The commerce affected by the project is mostly coal and salt for transshipment. Its volume is large and increasing.

It is believed that the harbor is of great convenience to general commerce, being a terminus of the Elgin, Joliet and Eastern Railway,

known as the Chicago Outer Belt Line. The harbor is in close connection with all the railways entering Chicago.

For reference to more extended information, maps, and reports on examinations and surveys, see Annual Report for 1904, page 532.

*Commercial statistics for 1906.*—Arrivals of vessels, 940; shipments and receipts, 202,199 net tons.

July 1, 1906, balance unexpended.....	\$48,967.51
Miscellaneous receipts.....	72.79
Amount appropriated by river and harbor act approved March 2, 1907.....	50,000.00
	<hr/>
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	99,040.30
	30,880.36
	<hr/>
July 1, 1907, balance unexpended.....	68,159.94
July 1, 1907, outstanding liabilities.....	7,809.19
	<hr/>
July 1, 1907, balance available.....	60,350.75
	<hr/>
July 1, 1907, amount covered by uncompleted contracts.....	7,600.00

(See Appendix K K 18.)

*19. Fox River, Wisconsin.*—The Fox and Wisconsin rivers, separated at Portage, Wis., by a distance of only 2 miles, one flowing into Lake Michigan, the other into the Mississippi River, were the early means of communication between those waters. Through a board of public works the State of Wisconsin began and carried on the improvement until 1853, when it was transferred to a private company. In 1872 the United States acquired possession of the property, with the exception of the water power, water-power lots, and personal property.

The present project is that of a Board of Engineers, submitted September 17, 1884, and modified May 14, 1886. It provides for deepening and widening the channel of the Fox River from Green Bay to Montello to 6 feet depth and from Montello to Portage to 4 feet depth, with a width of the river channels from Lake Winnebago to Montello of 100 feet, and for the renovation of 12 old locks.

The river and harbor act of March 2, 1907, provided for maintenance of harbors at Stockbridge, Fond du Lac, and Calumet, and authorized \$5,000, or so much thereof as may be necessary, for dredging and otherwise improving the harbor at Brothertown, on Lake Winnebago.

The improvement of the Wisconsin River was abandoned in 1887.

The amount expended on the improvement of the Fox and Wisconsin rivers from 1867 to the close of the fiscal year ending June 30, 1907, including \$145,000 paid to the Green Bay and Mississippi Canal Company for its property, was \$3,165,660.77, of which amount \$500,660.77 was appropriated solely for and expended solely upon the Fox River since 1885.

The works on the Fox River now consist of 18 stone locks, 2 stone guard locks and 8 composite locks, 13 canals, 16 permanent and 1 temporary dam, and various accessories, including lock houses, warehouses, a dry dock, levees, wasteweirs, culverts, retaining walls, etc. The harbors of Stockbridge, Calumet, and Miller Bay, Lake Winnebago, have been improved, and snags have been removed and bars

dredged in Wolf River, making a 4-foot channel 100 feet wide to New London.

The full depth of 6 feet has now been obtained from Depere to Princeton lock, except a section of 0.4 mile immediately above White River lock, where the work is now being prosecuted. The appropriation recommended will be applied to work on the 6-foot channel between White River lock and Montello.

The value of commerce involved is small compared with the cost of the improvement. Its principal effect so far, aside from the creation of valuable water powers, has been to cause a slight reduction in freight rates to points in the Fox River Valley. Deepening the channel of the upper Fox River by dredging has also had and will continue to have the effect of draining an enormous expanse of meadow lands in the Fox River Valley and greatly increasing their availability and value.

The maximum draft that could be carried June 30, 1907, at mean low water over the shoalest part of the improvement was 6 feet from Depere to White River lock, 4 feet from there to Montello, and 3 feet from Montello to Portage, the head of navigation on the Fox River.

July 1, 1906, balance unexpended.....	\$62, 232. 93
Miscellaneous receipts.....	1, 392. 89
Amount appropriated by river and harbor act approved March 2, 1907..	35, 000. 00

	98, 625. 82
June 30, 1907, amount expended during fiscal year, for works of improvement.....	16, 365. 85

July 1, 1907, balance unexpended.....	82, 259. 97
July 1, 1907, outstanding liabilities .....	33. 96

July 1, 1907, balance available .....	82, 226. 01
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July 1, 1907, amount covered by uncompleted contracts.....	6, 404. 36
Amount (estimated) required for completion of existing project....	75, 866. 48

(See Appendix K K 19.)

20. *Operating and care of locks and dams on Fox River, Wisconsin.*—Under the allotment from the indefinite appropriation for operating and care of canals and other works of navigation there has been expended during the year ending June 30, 1907, the sum of \$104,565.07.

The principal work has been dredging bars and channels; making repairs of locks, dams, canal banks, lock houses, dredges, and boats; rebuilding Appleton fourth lock; rebuilding the lower gates of Rapide Croche lock; building new tool houses at Kaukauna third and fourth locks, and building two new dump scows. The report of the local engineer officer in charge shows the items of expenditures. Navigation was closed November 22, 1906, and reopened April 6, 1907. The water in Lake Winnebago and the lower Fox has been maintained at or above the crests of dams throughout the year.

For commercial statistics see report of the local officer upon the improvement of Fox River, Wisconsin.

(See Appendix K K 20.)

21. *Removing sunken vessels or craft obstructing or endangering navigation.—Wreck of tug J. W. Bennett in Green Bay, Wisconsin.*—Sunk in collision with steamer *Saugatuck* August 18, 1906, about 11½ miles N. E. ½ N. from Tail Point light, in 32 feet of water; formed a dangerous obstruction to navigation.

On October 13, 1906, the wreck was formally abandoned by its owners.

On May 31, 1907, the wreck was entirely removed by the United States at a cost of \$443.

*Wrecks in Kewaunee Harbor, Wisconsin.*—The wrecks of tug *James N. Brooks*, schooner *Edith H. Koyen*, schooner *Exchange*, barge *Liberty*, and a small unknown vessel, lying within the established harbor lines of Kewaunee Harbor, Wisconsin, and having obstructed navigation for a period longer than six months, were entirely removed by the United States on November 22, 1906, at a cost of \$141.

(See Appendix K K 21.)

22. *Survey of Lake Winnebago, Wisconsin.*—The river and harbor act of March 3, 1905, contained an item authorizing a survey of Lake Winnebago, Wisconsin, for charting purposes only.

The survey was begun August 21, 1905, and the field work was completed September 10, 1906. The results of the survey were platted on seven sheets to a scale of 1:9600, and forwarded May 2, 1907, to the United States Lake Survey Office, Detroit, Mich., for charting and publication.

July 1, 1906, balance unexpended.....	\$2, 245. 56
October 25, 1906, allotted.....	1, 400. 00
Miscellaneous receipt.....	3. 29
	<hr/>
	3, 648. 85
March 21, 1907, transferred to Lake Survey Office.....	\$594. 33
June 30, 1907, amount expended during fiscal year.....	3, 054. 52
	<hr/>
	3, 648. 85

IMPROVEMENT OF CHICAGO AND CALUMET HARBORS, AND CHICAGO RIVER, ILLINOIS, OF CALUMET RIVER, ILLINOIS AND INDIANA, AND OF MICHIGAN CITY HARBOR, INDIANA; SURVEY OF ILLINOIS AND DES PLAINES RIVERS, ILLINOIS, FOR WATERWAY FROM LOCKPORT, ILLINOIS, TO ST. LOUIS, MISSOURI.

This district was in the charge of Lieut. Col. W. H. Bixby, Corps of Engineers.

1. *Chicago Harbor, Illinois.*—Before improvement (1870) this harbor was limited to the lower end of Chicago River, with an entrance channel width of 400 feet, depth of 13 feet, and annual commerce less than 3,000,000 tons. A brief history of this harbor improvement prior to 1876 is given on pages 433 to 438, Part 2, Annual Report, 1876, and a very full description of the harbor in its improved condition is to be found in pages 128 to 131, Bulletin No. 17 (1907), issued by the United States Lake Survey Office, Detroit, Mich.

The present project was adopted in 1870, modified in 1878, 1896, 1903, and 1905; that for present increased depth of dredging in outer harbor being given by report of July 16, 1897 (p. 2791, Annual Report, 1897), specifically adopted by act of March 3, 1899; and that for repair of north pier being given by report of July 14, 1903 (p.

1888, Annual Report, 1903), adopted by act of March 3, 1905; such projects including:

(a1) Breakwaters to form an outer harbor, with (a2) dredging within the same for 20-foot draft (21-foot depth).

(b) Exterior breakwater, with a harbor of refuge behind the same.

(c) Dredging entrance to inner harbor or mouth of Chicago River to same depth as outer harbor.

(d) Maintenance; including (d1) the special repair of north pier superstructure and (d2) some redredging outside the southern entrance to the basin.

(e) Contingencies, including superintendence.

For map of full improvement, see page 1888, Annual Report, 1903.

No preliminary examination reports appear to be on record as to past improvements of this locality.

A list of past survey reports will be found on page 600, Annual Report, 1906.

There has been expended in all on this work to June 30, 1907, the sum of \$1,995,076.87, of which \$209,140.41 is under estimates of the 1897 and 1903 projects.

The portions of the above project now in hand are (a2) completion of dredging of the outer harbor basin for a 20-foot draft, estimated July 16, 1897, at \$509,960; (d1) completion of repair of north pier superstructure, estimated July 14, 1903, at \$85,000; (d2) reopening (dredging) of the east (also called southern) entrance to the outer harbor basin; (d3) redredging of the entrance to Chicago River from the lake to Rush Street Bridge; (d4) repair of outer harbor breakwater cribs and filling; (d5) repair of exterior harbor of refuge breakwater; (e) contingencies, including superintendence.

At present the harbor entrance has a width of 470 feet at the river mouth, with a least depth of 20 feet via Chicago River, and of about 15 feet via the basin entrance; and the harbor basin carries depths of at least 20 feet over its outer half (portion fully dredged) and of at least 8 feet over its inner half; all these depths being referred to "Chicago city datum," or the so-called "low water of 1847," which is 579.83 feet above mean tide, New York Harbor (Lake Survey revisions of 1907).

The water level has a total variation of about 6.5 feet from highest known to lowest known water and an average of less than 1 foot oscillation per day. Its average for the calendar year of 1906 was 580.92 feet above mean tide, New York Harbor, or 0.98 foot above Chicago city datum.

Chicago outer harbor, being mainly a protection to Chicago River entrance, has practically no commerce except that of the river, the outer basin being used mainly by yachts and other small craft. The lake commerce of this locality is at present diminishing, and the harbor works, while formerly having added 5,000,000 tons to the river commerce, are now needed mainly to prevent a more rapid loss of the 5,000,000 tons now remaining.

The existence of this improved harbor is considered to be of great use in controlling freight rates.

It is proposed to apply the funds available toward the completion of the project by dredging in the outer basin, the rebuilding in con-



crete of the superstructure of the north pier, and to the maintenance of existing works.

July 1, 1906, balance unexpended.....	\$168, 015. 94
Amount appropriated by river and harbor act approved March 2, 1907.....	250, 000. 00

418, 015. 94

June 30, 1907, amount expended during fiscal year :

For works of improvement .....	\$51, 795. 84
For maintenance of improvement.....	25, 360. 51

77, 156. 35

July 1, 1907, balance unexpended.....	340, 859. 59
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July 1, 1907, amount covered by uncompleted contracts.....	72, 782. 73
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Amount (estimated) required for completion of existing project....	44, 960. 00
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(See Appendix L L 1.)

2. *Chicago River, Illinois.*—Before improvement by the United States (1896) the river channel, as a result of municipal and private improvement, was navigable for about 14-foot draft boats over widths of about 200 feet, and a length of about 1.5 miles in the main river; and of use by boats of 12 to 14 feet draft for lesser widths and for about 5 miles farther length in the North Branch, and about 5 miles farther length in the South Branch and forks. A good brief history of river and harbor improvement at Chicago prior to 1876 is given on pages 433–438, Part 2, Annual Report of the Chief of Engineers for 1876, and a very full description of present conditions is to be found in pages 131–141, Bulletin No. 17 (1907), issued by the United States Lake Survey Office, Detroit, Mich. For maps of river and turning basins, see pages 1892–1893, Annual Report, 1903.

Past projects, from 1896 to 1902, provided for 16 feet draft through this river. Under such projects 17 feet actual depth below city datum was secured from the mouth of the river via South Branch and West Fork to Ashland avenue (about 5.5 miles), via South Branch and South Fork to the stock yards (about 6 miles), and via North Branch to Belmont avenue (about 6 miles). (See p. 2974, Annual Report, 1893; p. 2793, Annual Report, 1897, and p. 3865 Annual Report, 1900, for full reports on history of improvement and needs up to 1899.)

The project of July 2, 1902, estimated cost \$500,000, as specifically covered by act of Congress June 13, 1902, provided for two large turning basins (one in the North Branch and one in the South Branch) to be dredged to 20 feet draft (21 feet depth). These turning basins have been completely dredged and partly docked, but will need some annual redredging and probably some further dock revetment.

A list of past survey reports will be found on page 601, Annual Report, 1906.

Reference to reports on examination and survey of West Fork of South Branch of Chicago River, ordered by the river and harbor act of March 3, 1905, will be found on page 608, Annual Report, 1906.

There has been expended on projects prior to 1902 \$448,520.51, and on the project of 1902, to June 30, 1907, the sum of \$460,562.52. Total, \$909,083.03.

The only other work still to be done in this river in connection with above projects is that of ordinary repair and maintenance, estimated at about \$10,000 per annum.

The river and harbor act, March 2, 1907, appropriated \$300,000 for improvement and maintenance of this river, such work being covered by the survey report of November 14, 1899 (pp. 3865-3871, Annual Report, 1900), and providing for dredging to 21 feet actual depth in mid-channel and to within 20 feet of dock lines from Ogden slip at the river mouth to Ashland avenue on the South Branch, to the Indiana State line bridges on the South Fork, South Branch, and to Belmont avenue on the North Branch (including also the canal around Goose Island, North Branch), all originally estimated at \$810,600.

*Tunnels under Chicago River.*—Under act of Congress approved April 27, 1904, the owners of the three tunnels under the Chicago River (by which the available draft in the river was reduced to 17 feet) were ordered to have these tunnels removed or lowered on or before April 15, 1906 (extended later to October 1, 1906), sufficiently to leave over them a clear depth of 22 feet at times of dead low water (i. e., that of Chicago datum) in Chicago Harbor (i. e., to 22 feet 5 inches at La Salle street, 22 feet 7 inches at Washington street, and 22 feet 10 inches at Van Buren street, below Chicago datum). Up to June 30, 1906, nothing was done toward actual modification of these tunnels, but city ordinance of June 18, 1906, gave the Chicago Union Traction Company authority to assume charge of actual construction work upon all three tunnels, to be commenced promptly and finished before the beginning of next year's navigation season. During the year the tunnel at La Salle street was removed by blowing off its top and dredging out the material to a depth of about 27 to 28 feet over about 200 feet center width of river. Time for completing the lowering of the Washington street and Van Buren street tunnels has been extended by the Secretary of War—for the former to August 1, 1907, and to March 1, 1908, for the latter. Their removal will give more than 20 feet depth of channel through the entire South Branch.

At present the river, including both branches, slightly widened at its narrowest parts by the United States and much widened in the South Branch by the Chicago Sanitary District, has a least depth of channel, as referred to Chicago city datum, of 20 feet from the lake to Dearborn Street Bridge, thence 18 feet to its branches; thence in the North Branch 12 feet to the north turning basin and 10 feet to Belmont avenue; and in the South Branch 17 feet to the south turning basin and through the West Fork and Sanitary District Canal to Lockport; and in the South Fork 17 feet to the stock yards. (For general description of the sanitary district projects and progress, see p. 2097, Annual Report, 1902.)

The water level has variations of about 6.5 feet from the highest known to lowest known water, and an average of less than 1 foot per day. The river has a current from the lake toward the Sanitary District Canal varying from nothing up to about 3 miles per hour, according to drainage diversion and lake seiches.

The annual commerce is now reported at about 5,000,000 tons, the principal items being grain, lumber, coal, and salt (a good deal of the local commerce having, since 1897, gone to the Calumet River),

and the present further improvement is now mainly needed to prevent further loss.

The existence of this improved river is considered to be of great use in controlling freight rates.

It is proposed to apply the funds now available and further appropriations to the completion of the turning basins, to the securing of the new 21 feet depth throughout the river, and to the maintenance of existing works.

July 1, 1906, balance unexpended.....	\$83, 876. 08
Amount appropriated by river and harbor act approved March 2, 1907.....	300, 000. 00

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383, 876. 08

June 30, 1907, amount expended during fiscal year:

For works of improvement.....	\$32, 181. 09
For maintenance of improvement.....	2, 599. 90

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34, 780. 99

July 1, 1907, balance unexpended.....	349, 095. 09
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Amount (estimated) required for completion of existing project.....	270, 000. 00
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(See Appendix L L 2.)

3. *Calumet Harbor, Illinois.*—This harbor is known on the Great Lakes as South Chicago Harbor.

Before improvement (1870) this harbor was limited to the lower end of Calumet River and to the natural depths over the bar at its lake mouth, the channel entrance having about 100 feet available width with about 4 feet depth. The annual commerce was practically nothing in either harbor or river. A brief history of this harbor improvement prior to 1876 is given on pages 441-444, Part 2, Annual Report, 1876; and a very full description of present conditions is to be found in pages 122-123, Bulletin No. 17 (1907), issued by the United States Lake Survey Office, Detroit, Mich.

This improvement was designed to furnish a safe and practicable entrance to Calumet River and the port of South Chicago by the construction of parallel piers 300 feet apart, projecting from the shore into Lake Michigan, and by dredging between them.

The work began in 1870, and all the projected work for 16 feet draft was accomplished prior to June 30, 1896, resulting in the construction of 3,640 linear feet of north pier and 2,020 linear feet of south pier, and securing and maintaining a channel 16 feet deep and of suitable width from water of similar depth in Lake Michigan to the Calumet River at the roots of the piers, at a cost of \$454,483.53.

The present project, submitted February 21, 1896, and specifically adopted by Congress by act of March 3, 1899 (including minor changes submitted March 28, 1899, modified July 1, 1902, and approved by Secretary of War July 11, 1902), provides for—

(a) A breakwater 4,400 feet long, connected with the shore and running due east into the lake, terminating in water 32 feet deep.

(b) An extension of this breakwater 2,500 feet long in a southeasterly direction from the end of the first.

(c) The anchorage area sheltered by breakwater dredged to 20 feet draft (21 feet depth).

(d) South pier at the mouth of Calumet River extended 800 feet.

(e) The Calumet River dredged to a width of 200 feet and 20 feet draft (21 feet depth) for a distance of 2 miles from the mouth.

## (f) Maintenance and repairs.

For text and map, including minor changes, see pages 2583-2588, Annual Report, 1896, and page 2102, Annual Report, 1902.

A statement of past examination and survey reports will be found on page 603, Annual Report, 1906.

There has been expended on this work to June 30, 1907, the sum of \$1,453,884.54, of which \$999,400.01 is under the existing project of 1896.

All original work of past and existing projects has now been completed, leaving since 1905 only its repair and other maintenance.

At present the protected harbor behind the lake breakwater is about 0.5 square mile in area with 20 feet depth; and the pier entrance to the river is of 300 feet width with at least 20 feet depth; all depths being referred to Chicago city datum. (See Chicago Harbor report.)

The water level has a total variation of about 6.5 feet from the highest known to lowest known water, and an average of less than 1 foot oscillation per day. Its average for the calendar year of 1906 was the same as that for Chicago Harbor.

Calumet Harbor, being mainly a protection to Calumet River entrance, has practically no commerce except that of Calumet River, although about half of the Illinois steel commerce, belonging partly to the harbor and partly to the river and estimated herewith, as usual, under Calumet River, belongs strictly to the harbor. The harbor works are fully entitled to half the credit of all the commerce developed by the combined harbor and river improvements since 1870, such development having now reached about 5,000,000 tons annually.

The existence of this improved harbor is considered to be of great use in controlling freight rates, and is claimed to save at least 50 cents per ton over Chicago River rates, and more over the usual Calumet (South Chicago) railroad rates.

It is proposed to apply the funds now available to the necessary repair and other maintenance of the works.

July 1, 1906, balance unexpended.....	\$95, 320. 31
Amount appropriated by river and harbor act approved March 2, 1907 .....	20, 000. 00
	<hr/>
	115, 320. 31
June 30, 1907, amount expended during fiscal year, for maintenance of improvement .....	1, 973. 85
	<hr/>
July 1, 1907, balance unexpended.....	113, 346. 46

(See Appendix L L 3.)

4. *Calumet River, Illinois and Indiana.*—Before improvement of Calumet Harbor by the United States (1870), this river, while having a navigable channel of about 100 feet width and 13 feet depth for about 4 miles length, could not be reached from the lake by boats of over 5 feet draft, because of the bar across its lake mouth; and its commerce was then practically nothing. At the time of the improvement of the river itself (1884), the river had become navigable for 12 feet draft over widths of about 100 feet and a length of about 4 miles; and for boats of 5 feet draft over widths of about 50 feet and lengths from the river mouth of about 16 miles in the Grand Calumet and about 14 miles in the Little Calumet. The commerce at that time

was, however, less than 500,000 tons. A good brief history of this river and harbor improvement prior to 1876 is given on pages 441-444, Part 2, Annual Report of the Chief of Engineers for 1876, and a very full description of present conditions is to be found on pages 123-125, Bulletin No. 17 (1907), issued by the U. S. Lake Survey Office, Detroit, Mich.

The first project for the improvement of this river, adopted by Congress in 1884 and modified in 1886, contemplated securing a channel 200 feet in width and 16 feet in depth below low water in Lake Michigan from the mouth of Calumet Harbor, Illinois, about 11 miles upward, to a point one-half mile east of Hammond, Ind. This project was modified by the river and harbor act of June 3, 1896, for Calumet Harbor, so as to provide for dredging the channel to 20 feet depth from the mouth 2 miles southward (upward).

The projects of 1884 to 1896, now ended, secured a permanent channel of 200 feet width and 20 feet depth from the mouth of the river about 2.5 miles upstream (including a small turning basin near the mouth of the river), thence 16 feet depth about 3 miles farther, except over short portions where rock reduced the width to 85 feet and the depth to 14 feet; and, in addition, a temporary channel of 10 feet depth and 60 feet width, in the next 6 miles, up to a point on the Grand Calumet 0.5 mile east of Hammond, Ind. (about 11 miles above the mouth).

The present projects, adopted by act of March 3, 1905, provided for a channel 200 feet wide and 20 feet deep from the mouth of the river to One hundred and twenty-second street, and of the same width and 16 feet deep from One hundred and twenty-second street to the forks, with five turning basins, at a total estimated cost of \$662,480.50, and \$10,000 per annum for maintenance. (See p. 605, Annual Report, 1906.)

(For estimates in full, see pp. 2942-2949, Annual Report, 1904; for map, see p. 1902, Annual Report, 1903; also, for fuller details, see House Doc. No. 172, Fifty-eighth Congress, second session.)

For this work \$542,500 has been appropriated, and \$170,000 more of contracts authorized (and not yet appropriated), thus providing for the entire project and allowing five years of maintenance at \$10,000 per year.

The act of June 13, 1902, authorizes the Secretary of War to accept deeds, free of expense to the United States, for lands necessary to make a proper channel 200 feet wide from the forks up to a point 0.5 mile above Hammond, Ind. (a stretch of about 5.5 miles), and the act of March 3, 1905, authorizes similar deeds for lands necessary for turning basins in the river below the forks.

Under appropriation of August 18, 1894, for "above the forks," \$5,150.75 is still available, but dredging has been discontinued because of constant refilling, as explained in project of August 3, 1903. During the year a resurvey of this part of the river has been made to relocate the ground in such way that owners may know just what property is to be ceded to afford the best results to navigation.

A statement of past examination and survey reports will be found on page 605, Annual Report, 1906.

There has been expended to June 30, 1907, on works of all projects the sum of \$586,301.68, of which \$140,533.45, including \$3,511.50 for maintenance, is under the project of 1903.

Expenditures up to date have resulted in a channel of 21 feet depth (Chicago datum) from the river mouth to One hundred and sixth street, with 300 feet width at the harbor piers, diminishing to 200 feet width at about Ninety-second street, retaining 200 feet width to One hundred and sixth street (except at bridges); thence 20 feet depth with 200 feet width to One hundred and eleventh street; thence 21 feet depth with 200 feet width to One hundred and fourteenth street (except for a distance of about 1,600 feet, covered by rock and hardpan, where there is only 50 feet clear width and where rock excavation is now in progress with expectation of securing 200 feet width in 1907); thence 14 feet depth with 200 feet width to a point 900 feet above Chittenden Bridge (near One hundred and twenty-third street); thence about 5 feet mid-channel depth and 100 to 150 feet river width (undredged) to the forks; thence about 5 feet depth with about 50 feet width (dredged prior to 1895 to 10 feet depth and to 60 feet width, but since partly filled up) to Hammond, Ind. One small turning basin has been dredged just above Ninety-second street with 250 feet least diameter and about 15 feet depth. The river is further navigable for 6-foot-draft boats to Riverdale on the Little Calumet, 12 miles from the river mouth. It can also be used by light-draft launches, such as can pass under bridges, nearly to Gary on the Grand Calumet, about 20 miles from the river mouth, and to Blue Island on the Little Calumet, about 14 miles from the river mouth, being stopped at that point by rapids.

The water level has variations of about 6.5 feet from highest known to lowest known water, and an average of less than 1 foot per day. At dead low water the river is practically level from the lake up to the junction of the Grand and Little Calumet. The current is very slight except during freshest and lake seiches.

An application of the Sanitary District of Chicago for permission to reverse the flow of Calumet River, so as to cause the water to flow from Lake Michigan into the drainage canal (in a similar manner as has been done in the Chicago River), was denied by the War Department March 14, 1907.

The annual commerce is now reported at 5,290,000 tons, the principal items being iron ore, grain, and coal. It is steadily increasing, and new manufacturing plants are steadily occupying the river banks as fast as the 20-foot depths are carried upstream.

The existence of this improved river is considered to be of great use in controlling freight rates, and is claimed to save at least 50 cents per ton over Chicago River rates, and more over the usual Calumet (South Chicago) railroad rates.

It is proposed to apply the funds now available and those asked for for the year ending June 30, 1909, to continuing the enlargement of the channel progressively upstream according to the 1903 project, and to the construction of the turning basins authorized under such project, as soon as the land needed therefor be deeded to the United States.

July 1, 1906, balance unexpended.....	<sup>a</sup> \$241, 963. 21
Amount appropriated by river and harbor act approved March 2, 1907.....	191, 500. 00
Amount appropriated by sundry civil act approved March 4, 1907....	20, 000. 00
	<hr/>
June 30, 1907, amount expended during fiscal year, for works of improvement.....	453, 463. 21
	<hr/>
July 1, 1907, balance unexpended.....	<sup>a</sup> 407, 917. 30
July 1, 1907, amount covered by uncompleted contracts.....	201, 003. 48
Amount (estimated) required for completion of existing project....	170, 000. 00
	<hr/>
{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907.....	170, 000. 00
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

(See Appendix L L 4.)

5. *Michigan City Harbor, Indiana.*—[This work was in the charge of Col. M. B. Adams, Corps of Engineers, until June 7, 1907.] The inner and outer harbors were formerly separate works. They are now consolidated in consequence of the requirements of the river and harbor act of June 13, 1902.

The improvement of this harbor dates from 1836, and has resulted in establishing an inner harbor for local commerce and partly completing an outer harbor designed to facilitate entrance to the former and afford refuge for vessels engaged in general lake commerce.

*The inner harbor.*—This has been made by deepening the entrance to Trail Creek and protecting the channel by piers extending to deep water in Lake Michigan, to which operations were limited until 1870. The original depths before improvement were 9 feet upon the outer bar and  $3\frac{1}{2}$  feet or less at the entrance to the inner harbor; and the width varied from 175 feet in the lower portion to 60 feet or less in the upper portion. Since 1882 the entrance channel has been prolonged up the creek by dredging between revetments, so fast as they are built on established wharf lines at the expense of the adjoining property owners, as required by city ordinance.

No recent general project for the expenditure of funds has been definitely called for; and work for the past twenty years has been based upon securing a 15 feet draft at low water to within about 25 feet of dock lines, as indicated in the Annual Reports of 1879 to 1882, and over a length of river from the lake up to the present Lake Erie and Western Railroad bridge, as shown on maps in the Annual Reports for 1882 (p. 2270) and 1896 (p. 2676). The practice in this river has been for the General Government to do all work outside the general shore line of the lake and the dredging in the river channel, and for the city or private owners to put in the docking of the river front and make necessary repairs to private slips and harbors. The maps of the 1882 and 1896 reports show a medium sized upper turning basin, a small middle turning basin; while appropriations of

<sup>a</sup> Includes \$5,257.70 for "above the forks."

March 3, 1905, provided for widening the river at its lowest bend sufficient to form a large lower turning basin between the lake and the first bridge of the river (completed April 30, 1906).

A recent act of the Indiana legislature now allows the city to build revetments and to assess their cost upon the property benefited, as in cases of sewer construction; and such extensive reconstruction of revetments is soon to be made as to allow the channels to be deepened to 20 feet from the entrance to Franklin Street Bridge, to 18 feet from there to the railroad bridge, and to 16 feet thence to the upper end of the harbor as soon as funds become available for such work.

In recent years the channel improvement, with the exception of the lower turning basin, has been purely one for maintenance, and has resulted in creating, by dredging, a channel 9,159 feet long between revetments from 100 to 175 feet apart, except at the turning basins, where the width is about 330 feet. The upper limit of this improved channel is 100 feet above the upper turning basin on the map above referred to; but above the lower part of the upper basin the channel has shoaled and is not available for lake vessels.

The completion of the project of 1882-1896 requires that this dredging shall be extended upstream about 1,000 feet beyond the upper turning basin (about 64,000 cubic yards, now estimated at about \$16,000).

The piers forming the lake entrance to the river, originally treated as part of the inner harbor, are now treated as a part of the outer harbor and are described below under that head.

The total expenditure to June 30, 1902, the date of consolidation with outer harbor, was \$438,365.50. Of this total, \$287,383.77 was expended from 1836 to 1869, inclusive, principally upon pier construction, but it is now impossible to separate the cost of maintenance for this period from that of original construction. Since 1869, \$153,286.92 in all has been expended, of which \$56,724.74 was applied to maintenance.

Dredging operations were carried on by the U. S. suction dredge *General Gillespie* in May and June, and by a contract dredge in June; all being of the nature of maintenance.

The commerce benefited by the improvement is purely local in character, the principal business being in lumber and salt, which are brought from the northern harbors by small steam barges and by sailing vessels.

The channel does not maintain itself, and provision should be made for periodical dredging.

*The outer harbor.*—Michigan City, being at the southern end of the lake, is exposed to northerly storms, especially those from west of north, with a clear sweep of the length of the lake, about 250 miles. As a result there arose a demand for a harbor of refuge in this vicinity, which was answered in 1870 by the adoption of a project for the creation of an outer harbor at this place, which was to consist of an outer basin east of the entrance to the inner harbor. In 1882 this project was extended to include the construction of an exterior breakwater northwest of the entrance. The piers and breakwaters covering the outer basin were completed in 1885, and have a total length of 3,171 feet, measured on the harbor face, viz, a pile pier, 1,225 feet long, extending in a northerly direction



from the shore and closing the basin on the east; a crib breakwater, 1,411 feet long, extending westward from the lake end of the pile pier and closing the basin on the north, and a crib pier, 535 feet long, measured from the angle in the harbor face, or 505 feet measured from the rear face of the breakwater, extending northward from the west end of the crib breakwater. The exterior breakwater contemplated by the project of 1882 was to have a total length of 2,000 feet, but a length of only 700 feet had been built.

The river and harbor act of March 3, 1899, authorized the adoption of the project of a Board of Engineers as printed in the Annual Report of the Chief of Engineers for 1897, pages 2899 to 2904, inclusive, and provided for the completion of the work under the continuing-contract system. This project requires the extension of the breakwater pier by 600 feet, the construction of a new detached breakwater 1,500 feet long, and the removal of the present detached breakwater. The estimated cost of the work was given at \$282,150, but it is now evident that this sum will be exceeded.

Up to June 30, 1907, the sum of \$1,124,915 had been expended upon the original project and its subsequent modifications. Of this amount \$760,531.53 had been expended upon the projects of 1870 and 1882, of which \$134,970.44 was applied to maintenance. The total amount expended upon revised projects to June 30, 1906, was \$364,383.47, of which \$309,621.73 was for new construction and \$54,761.74 for maintenance.

The Annual Report of the Chief of Engineers for 1897, pages 2899 to 2904, contains the full report of the Board of Engineers referred to above, and a map showing the outlines of the present project is opposite page 2904 of that report.

The district officer reports that to complete the original project will require a further appropriation of \$30,000 for original dredging, in addition to \$10,000 for ordinary maintenance of redredging channel and repairing piers.

The funds in hand will be expended toward completion of original project and for maintenance and contingencies.

Information received as to the effect of the project on freight rates is meager, but indicates that in a general way the improvement has a tendency to reduce charges and secure advantageous charters for shippers. The present commerce is shown by tables in the appendix.

July 1, 1906, balance unexpended.....	\$27, 288. 46
Amount appropriated by river and harbor act approved March 2, 1907.....	60, 000. 00
	<hr/>
	87, 288. 46
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	2, 305. 19
	<hr/>
July 1, 1907, balance unexpended.....	84, 983. 27
	<hr/>
July 1, 1907, amount covered by uncompleted contracts.....	2, 000. 00

(See Appendix L L 5.)

6. *Survey of Illinois and Des Plaines rivers, Illinois, for waterway from Lockport, Ill., to St. Louis, Mo.*—This work was provided for by act of June 13, 1902, which appropriated \$200,000 therefor. The survey was completed and final report rendered August 26, 1905, by a special Board of Engineer officers appointed under the provisions of said act. The report was published as House Document

No. 263, Fifty-ninth Congress, first session. This report was reviewed by the Board of Engineers for Rivers and Harbors, whose report, dated December 8, 1906, is printed in House Document No. 437, Fifty-ninth Congress, second session.

The consideration, by a Commission, of the survey heretofore made of this waterway, including the questions of water power and drainage of land, is provided for by the river and harbor act of March 2, 1907, in connection with an examination of the Mississippi River from St. Louis to its mouth (see p. 812 of this report).

A statement of past examination and survey reports will be found on page 607, Annual Report, 1906.

July 1, 1906, balance unexpended-----	\$332. 20
June 30, 1907, amount expended during fiscal year-----	332. 20

(See Appendix L L 6.)

7. *Removing sunken vessels or craft obstructing or endangering navigation.*—(a) *Sloop Peri, in North Branch of Chicago River, near Fullerton avenue.*—The wreck of this vessel was reported as an obstruction to navigation by the department of public works of the city of Chicago, which stated it was abandoned and that the owners could not be located. The wreck was raised, found worthless, and destroyed, at a total cost to the United States of \$251.51.

(b) *Schooner barge H. A. Richmond, in the main branch of Chicago River, near Rush Street Bridge.*—The wreck of this vessel was reported as an obstruction to navigation by the department of public works of the city of Chicago. The wreck having been formally abandoned, it was raised, found worthless, and was then sunk in Lake Michigan in 50 feet depth of water in such way as to no longer interfere with navigation, at a total cost to the United States of \$817.77.

(See Appendix L L 7.)

#### IMPROVEMENT OF ILLINOIS RIVER AND CONSTRUCTION OF ILLINOIS AND MISSISSIPPI CANAL, ILLINOIS.

This district was in the charge of Maj. C. S. Riché, Corps of Engineers. Division engineer, Lieut. Col. W. H. Bixby, Corps of Engineers.

1. *Illinois River, Illinois.*—(a) *Below Copperas Creek.*—The project, which contemplates the extension of slack-water improvement begun by the State of Illinois from Copperas Creek lock to the Mississippi River, and which includes the construction of two locks 350 feet long between sills, 75 feet width of chamber, with 7 feet of water over sills at low-water level of 1879, and dredging the channel where necessary to obtain 7 feet depth at low water, was adopted in 1880.

The United States has expended on this work up to June 30, 1907, \$1,515,720.77, of which \$10,937.14 was expended during the fiscal year in maintenance of plant, care and repair of property and plant, snagging, and dredging.

The lock and dam at Kampsville, Ill., 31 miles above the mouth of Illinois River, has been completed and in use since 1894, and that at La Grange, 79 miles above the mouth, since 1890.

The State of Illinois, aided by the United States, has executed part of the general project by the construction of locks and dams at Henry and at Copperas Creek, completing, except dredging, that part of the

project between La Salle and the mouth of Copperas Creek, a distance of about 90 miles, over which section the State of Illinois collects tolls.

Minor repairs to fleet and plant were continued during the year. Periodical inspection trips were made throughout the navigable length of the river to remove snags, supervise work in progress under permits, and to prevent encroachments upon the river channel.

Harbor lines on both sides of the river at Peoria have been established.

The navigation of the river for the calendar year 1906 shows an increase of 50 per cent as measured by the arrivals and departures at St. Louis.

At the close of the fiscal year the river shows a navigable depth of 7 feet, except where bars have formed, and such bars will be removed. Considerable work remains to attain the project width of 200 feet at all points.

The improvement of Illinois River has been in progress many years, and the present navigable depth has obtained at ordinary stages of the river for several years, during which freight rates in the vicinity have decreased to some extent; but as freight rates generally have diminished during these years, it is impossible to state whether the effect of river competition is shown in diminished railroad freight rates. The closing of the river to navigation, however, would unquestionably lead to a rise in freight rates on the adjacent railways, and as the volume of freight affected would be large, a good navigable condition should be maintained.

It is proposed to apply the available funds toward maintaining the navigable channel of 7 feet depth between Copperas Creek dam and the mouth of the river, removing snags, care and repair of plant and property, and in making such local surveys as may be necessary from time to time.

July 1, 1906, balance unexpended.....	\$31, 589. 58
Amount received from sale of plant.....	300. 00
Amount appropriated by river and harbor act approved March 2, 1907.	50, 000. 00
	<hr/> 81, 889. 58
June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$7, 937. 14
For maintenance of improvement.....	3, 000. 00
	<hr/> 10, 937. 14
July 1, 1907, balance unexpended.....	70, 952. 44
July 1, 1907, outstanding liabilities.....	1, 500. 00
	<hr/> 69, 452. 44
July 1, 1907, balance available.....	<hr/> 142, 000. 00
Amount (estimated) required for completion of existing project.....	

(b) *From Copperas Creek to La Salle.*—The first appropriation for this section of the river was made March 2, 1907, and the approved project for its expenditure provides for securing the same navigable conditions from Copperas Creek to La Salle as are planned for the lower river, i. e., a channel depth of 7 feet at low water.

The operations since March 2, 1907, have included a snagging trip by the steamer *Col. A. Mackenzie*; preparations are in progress for additions and repairs to plant for dredging purposes; surveys have been made to locate shoal points and bars. Surveys, dredging, and

inspection on this section of the river will be carried on with the same plant as is used on the lower section.

It is proposed to apply the available funds to securing and maintaining a navigable channel of 7 feet depth, snagging, care, and repair of property and plant, inspection and prevention of obstructions and encroachments, and such local surveys as may be necessary.

Amount appropriated by river and harbor act approved March 2, 1907. \$50,000. 00  
 June 30, 1907, amount expended during fiscal year, for works of improvement ----- 1,500. 48

July 1, 1907, balance unexpended ----- 48,499. 52  
 July 1, 1907, outstanding liabilities ----- 500. 00

July 1, 1907, balance available ----- 47,999. 52

(See Appendix M M 1.)

2. *Operating and care of La Grange and Kampsville locks, Illinois River, and approaches thereto.*—These locks and dams have been maintained and operated under the indefinite appropriation provided for in section 4 of the river and harbor act of July 5, 1884.

(a) *La Grange lock and dam.*—The river was open to navigation the entire year except two weeks. Boats passed the lock every month in the year. From July 1, 1906, to March 10, 1907, all boats passed through the lock; since March 10, most of passing boats have gone over the dam.

There was expended during the year \$6,588.27.

(b) *Kampsville lock and dam.*—The river at this point was open to navigation the entire year except ten days. From July 1 to December 16 all boats passed through the lock; since March 7, 1907, most passing boats have gone over the dam.

There has been expended during the past year \$6,471.86.

(See Appendix M M 2.)

3. *Illinois and Mississippi Canal, Illinois.*—The object of the improvement is to furnish a link in a navigable waterway from Lake Michigan to the Mississippi River at the mouth of Rock River, Illinois.

The canal has been located on the Rock Island route, approved by the Secretary of War October 27, 1888, as directed in the act of Congress of August 11, 1888. It proceeds from the Illinois River at its great bend, 1 $\frac{3}{4}$  miles above the town of Hennepin, Ill.; thence via Bureau Creek Valley and over the summit to Rock River at the mouth of Green River; thence by slack water in Rock River and a canal around the lower rapids of the river at Milan to the Mississippi River at the mouth of Rock River.

The canal is to be at least 80 feet wide at the water surface, 7 feet deep, and with locks 170 feet long and 35 feet width of lock chamber, capable of passing barges carrying 600 tons (maximum) freight.

A report upon the location, with detailed estimate of cost, of this canal was submitted June 21, 1890, and is printed in the Annual Report of the Chief of Engineers for 1890, page 2586.

The river and harbor act of September 19, 1890, made the first appropriation for the construction of the canal, and directed work to be begun by the construction of one of the locks and dams in Rock River.

In accordance with this act work was begun in July, 1892, near the mouth of Rock River, on the construction of a canal around the lower rapids of the river, and since that date has been prosecuted as rapidly as the appropriation of funds permitted. The survey work in locating the canal on the ground and proceedings for acquiring title to the right of way have been completed, and the canal has been definitely located on the ground throughout its entire extent.

There has been expended on this work up to the close of the fiscal year ending June 30, 1907, \$7,188,696.87, of which \$267,755.92 was expended during the fiscal year.

The result of this expenditure has been:

First. The acquisition of the right of way for  $4\frac{1}{2}$  miles around the lower rapids of Rock River and the completion of  $4\frac{1}{2}$  miles of canal there, involving the construction of  $4\frac{1}{2}$  miles of earthwork, 3 locks, 1 railroad and 2 highway swing bridges, 7 sluiceways and gates, 1 arch culvert, 2 dams 1,392 feet long across the arms of Rock River, 3 lock-keepers' houses, 1 small office building, a thorough riprapping of the canal banks (not included in the original estimates), and construction by contract of Moline wagon bridge, at a cost of \$25,000, which was also not included in the original estimate.

Second. In the location on the ground and preparation of descriptions, plats, and abstracts of title of all lands needed for the construction of the canal and feeder, and for lands to be overflowed or damaged by the canal at Sterling.

Third. In the practical completion on the eastern section of all earthwork, except cleaning up, strengthening, raising, and widening banks at some points, and removing deposits and debris; completion of foundations, masonry, and gates of all culverts and locks; construction of 3 aqueducts; construction of 18 highway bridges and 1 farm bridge, 3 railroad bridges, 11 arch culverts, and 11 pipe culverts; the erection of 5 houses for superintendents and 2 houses for office use, and acquiring additional land for deposit of waste material on miles 21, 22, and 23; necessary revetment, intakes, ditches, docking, and 12 miles of telephone line.

Fourth. In the acquisition by condemnation or purchase of all lands required for the canal feeder.

Fifth. In the construction of all earthwork on the feeder except 11 cross banks; completion of 9 arch and 10 pipe culverts; completion of masonry and abutments and superstructures of all highway bridges except masonry and superstructure of No. 45; completion of 2 railway bridges and superstructure of 1 double-track railway bridge and 2 single-track railway bridges; excavation of about 75,000 cubic yards of rock in mile 1, and distribution of same in the form of riprap along the interior slopes of the feeder; construction of masonry, back filling, foundations, slope paving, steel work, and concrete lining of aqueduct crossing Green River; construction of masonry of lock, sluiceways, and abutments for headworks of feeder, and lock and sluice gates erected; erection of combined office and residence at head of feeder; construction of masonry and sills for feeder dam.

Sixth. In acquiring lands for the right of way, including land to be damaged by overflow and land upon which to deposit waste material, on western section; execution of all earthwork, except cross bank at Lock 28, and execution of 9,800 cubic yards of rock work; completion of all culverts, locks, aqueducts, highway and railway bridges, and building of three lock houses and eight warehouses.

The entire work embraced in the original project for the canal, as modified by subsequent projects and plans as the work has progressed, may be summarized as follows:

Surveys and location upon the ground.  
Acquisition of right of way and fencing.

Construction of—

95.8 miles of earthwork.  
67 highway bridges.  
1 farm bridge.  
3 ponton bridges.  
8 railroad bridges.  
9 aqueducts.  
52 culverts.  
33 locks.  
9 sluiceways and gates.  
3 dams.  
19 houses.  
Outlet to Rock River.  
New highway on mile 16.  
Improvement of 8.5 miles of Rock River.  
Moline wagon bridge (not in original estimate).

The work thus far completed may be summarized as follows:

Surveys and location upon the ground.  
Acquisition of right of way and fencing.

Construction of—

95.8 miles of earthwork (except cross banks, etc.).  
66 highway bridges.  
1 farm bridge.  
8 railroad bridges.  
9 aqueducts.  
52 culverts.  
33 locks.  
9 sluiceways and gates.  
2 dams.  
14 houses.  
New highway on mile 16.  
Moline wagon bridge.  
Outlet to Rock River.

The work remaining to be done consists of the following as far as it can be classified at present.

Dam at head of feeder.  
Excavation of cross banks and finishing work.  
Superstructure and part of masonry of 1 highway bridge.  
1 ponton bridge.  
Emergency gates at crossing of Green River.  
Emergency gates in Cecils Slough, mile 23.  
Five or more houses.

Improvement of 8.5 miles of Rock River (under Rock Island office).

Miscellaneous work consisting of revetment, bank protection, painting, closing gaps, building intakes, reflooring bridges, rebuilding fences, maintenance, slope paving, calking gates, raising and widening banks, cleaning up, etc.

July 1, 1906, balance unexpended	\$527,034.52
Amount received from sale of plant, etc.	46,558.95
	<hr/> 573,593.47
June 30, 1907, amount expended during fiscal year, for works of improvement	<sup>a</sup> 267,755.92
July 1, 1907, balance unexpended	305,837.55
July 1, 1907, outstanding liabilities	15,000.00
	<hr/> 290,837.55
July 1, 1907, balance available	21,500.00
July 1, 1907, amount covered by uncompleted contracts	21,500.00
(See Appendix M M 3.)	

#### IMPROVEMENT OF RIVERS AND HARBORS IN MICHIGAN ON THE EASTERN SHORE OF LAKE MICHIGAN.

This district was in the charge of Col. M. B. Adams, Corps of Engineers. Division engineer, Col. G. J. Lydecker, Corps of Engineers.

*General statement as to the usual variations in the level of the lake surface at all the harbors on the eastern shore of Lake Michigan.*—The level of the lake surface varies considerably from time to time. At present its highest stage may be stated as from 0.5 to 1 foot below mean low water, and obtains from the end of June to the middle of August. Its lowest stage is between 1.5 and 2 feet below mean low water, and obtains with slight change from early in November to early in April. All depths at the various harbors in this report refer to zero of gage, which is 581.63 feet above mean tide at New York.

*1. St. Joseph Harbor and River, Michigan.*—These were formerly carried as separate works, but are now combined in consequence of a provision in the river and harbor act of June 13, 1902.

(a) *St. Joseph Harbor.*—This harbor is formed by the junction of the St. Joseph and Pawpaw rivers and extends along the city front of St. Joseph, and in its original condition had a natural width of 800 feet, which has been reduced to 300 feet by wharves built upon the approved harbor lines. It has been under improvement by the United States since 1836, previous to which time there was a narrow and crooked channel with depths which varied from 3 to 7 feet. The original project of 1836 is not clearly known. Up to 1866 there were built 1,100 feet of north pier and 212 feet of south pier, which protected a cut through the narrow tongue of land to the north of the old river mouth, the width between the piers being 240 feet, which became 257 feet through subsequent repairs. In all \$162,113 was expended upon this work. In 1866 the first definitely known project was adopted, and this proposed the extension of the south pier 200 feet for the purpose of facilitating the creation of a direct channel of 16 feet depth through the bar at the entrance. The project of 1866 was modified in 1874, 1875, 1880, and 1892, the changes having reference principally to the length and direction of the two piers. The Benton Harbor Canal, which is about 1 mile long and extends from the upper part of the harbor to the town of Benton Harbor, was taken over by the United States for the purpose of care, main-

<sup>a</sup> Includes \$20,000 allotted Rock River pool.

tenance, and improvement in 1880. In all there was expended upon these various projects \$503,113.23.

The river and harbor act of March 3, 1899, adopted the present project, which is printed in the Annual Report for 1898, pages 2496-2498. This project provides for an entrance channel 18 feet deep and for an interior channel 18 feet deep and 150 feet wide along the city front of St. Joseph, while the Benton Harbor Canal and the turning basin at the mouth of the St. Joseph River are to be dredged to 15 feet; the north pier to be extended 1,000 feet, and the south pier, upon a line parallel with the north pier, 1,800 feet. The width between is 330 feet at the entrance, narrowing to 257 feet inside. The estimated cost of completion of the existing project was given in the above report at \$380,000. Up to June 30, 1907, there had been expended upon the existing project \$358,683.55, of which \$55,590.17 was applied to maintenance. Operations since June 25, 1900, have been in progress for the purpose of completing all the work contemplated. As a result of the above expenditures, 1,000 feet has been added to the north pier and 1,800 feet to the south pier, and in November, 1901, the proposed dredging had been completed so far as practicable. Deterioration in the dredged channels has since taken place. The bar just beyond the ends of the piers still persists and until this year limited the maximum through draft to 16.6 feet. During the past year, however, the channel through the outer bar, dredged to 20 feet, so as to provide an 18-foot depth during storms, has maintained that depth unusually well; nothing less than 20 feet in depth was found on the bar at the survey May 13-21, 1907. To complete the existing project the dredging through this bar will have to be done from time to time, and annual dredging will be required.

The north pier and revetment measure 2,854 feet—2,183.5 feet being crib work and 670.5 feet pile work. At the east end a wing 165 feet long connects it with the dock of the United States light-house depot. The south pier is 2,623 feet long, 1,800 feet being crib work and 820 feet pile work. These structures are in good condition, except the 165 feet of wing at east end of north pier; also 150 feet of decking at station 0, north pier, and filling of outer pockets of south pier from station 25 to the outer end are needed.

All new construction work under the authorized project has been completed, and the existing works on the entrance channel are in serviceable condition.

During the year the channel to shore line between the piers was deepened to 20 feet, thence to the Benton Harbor Canal to 18 feet, the width of the dredged channel being about 150 feet. Of the balance on hand it is proposed to reserve \$1,500 as part payment for an inspection steamer and to expend the remainder in dredging and repairs of piers.

The soundings show considerable shoaling of the channels since the general dredging operations in 1901. The accretions causing this deterioration are due to sand brought down by the St. Joseph and Pawpaw rivers during floods, and as this is a matter of annual recurrence dredging for the restoration of the channel may be expected to be required from year to year.



The principal traffic benefited by this improvement is the fruit traffic and the carrying of passengers, including excursionists, to the summer resorts in this vicinity. Both classes of traffic show continuous growth. The entire traffic is served by a single line of steamers, which, however, during the summer runs from two to four boats daily, some of these being of very great size.

House Document No. 307, Fifty-fifth Congress, second session, reproduces a map accompanying the present revised project, which is not republished in the Annual Report of the Chief of Engineers for 1898.

(b) *St. Joseph River*.—This is a crooked stream, obstructed by numerous shoals, with depth in channel crossings of from 24 to 30 inches. The intervening pools are generally from 4 to 8 feet deep. The part under improvement is from the mouth at St. Joseph to Berrien Springs, a distance of about 25 miles by river. The improvement of this section to make a low-water channel 3 feet deep has been in progress since 1889, and consists in removing snags and logs and closing secondary channels, or concentrating the flow at other critical points by dams of brush, logs, and stone.

The amount expended to June 30, 1907, was \$6,246.26, of which \$4,555.49 was for construction and \$1,690.77 for maintenance, as a result of which many of the worst places of the stream had been improved to the required extent.

Operations on the St. Joseph River usually comprise a small amount of wing-dam construction, the removal of overhanging trees and snags by a force of hired laborers; some work of wing-dam construction was done during the year at an expense of \$296.75.

The average annual expenditure has been \$500.

The traffic benefited by this improvement is a limited one, three small steamers being employed to carry passengers (almost exclusively summer tourists) and a small quantity of freight, which is principally fruit.

The money on hand will be expended in maintenance and contingencies.

The effect of the improvement on freight rates can not be stated.

#### *Entrances and clearances.*

##### ST. JOSEPH HARBOR.

Calendar year.	Number.	Tonnage.
1905 .....	1,373	733,600
1906 .....	1,323	926,976

#### Total freight carried, calendar year—

1905 .....	tons..	118,412
1906 .....	tons..	115,839

##### ST. JOSEPH RIVER.

#### Total freight carried, calendar year—

1905 .....	tons..	2,530
1906 .....	tons..	2,034

#### Passengers carried in—

1905 .....	23,377
1906 .....	20,372

## ST. JOSEPH HARBOR.

July 1, 1906, balance unexpended-----	\$15,192.83
Amount allotted from appropriation by river and harbor act approved March 2, 1907-----	15,000.00
	<hr/>
June 30, 1907, amount expended during fiscal year, for maintenance of improvement-----	30,192.83
	2,649.76
	<hr/>
July 1, 1907, balance unexpended-----	27,543.07
July 1, 1907, outstanding liabilities-----	1,300.00
	<hr/>
July 1, 1907, balance available-----	26,243.07

## ST. JOSEPH RIVER.

July 1, 1906, balance unexpended-----	\$300.49
Amount allotted from appropriation by river and harbor act approved March 2, 1907-----	1,000.00
	<hr/>
June 30, 1907, amount expended during fiscal year, for maintenance of improvement-----	1,300.49
	296.75
	<hr/>
July 1, 1907, balance unexpended-----	1,003.74

## CONSOLIDATED.

July 1, 1906, balance unexpended-----	\$15,493.32
Amount appropriated by river and harbor act approved March 2, 1907-----	16,000.00
	<hr/>
June 30, 1907, amount expended during fiscal year, for maintenance of improvement-----	31,493.32
	2,946.51
	<hr/>
July 1, 1907, balance unexpended-----	28,546.81
July 1, 1907, outstanding liabilities-----	1,300.00
	<hr/>
July 1, 1907, balance available-----	27,246.81

(See Appendix N N 1.)

2. *South Haven Harbor, Michigan.*—This harbor is situated at the mouth of Black River. Improvements were begun in 1867, at which time there existed a channel 7 feet deep and 85 feet wide between slab piers. These piers had been built by residents of the vicinity, at a cost of about \$18,000. The banks of the river for 500 feet on each side had a rough protection of close piling.

The project of 1866, as modified in 1869, 1872, and 1888, provided for constructing parallel piers and revetments 175 feet apart at the mouth of Black River, with the object of procuring a channel 12 feet deep, and extending the navigable channel one-half mile up Black River to the highway bridge by dredging.

The act approved March 3, 1905, adopted the project, as per House Document No. 119, Fifty-eighth Congress, second session, and provides that none of the \$50,000 appropriated for the improvement shall be used, except for maintenance of existing channels, until proper dock lines shall have been established and suitable bulkheads shall have been built along these lines by the city of South Haven or by the riparian owners, and the property lying on the channel side of these dock lines shall have been deeded to the United States free of cost.

By joint resolution of Congress, June 29, 1906, \$10,000 of the March 3, 1905, appropriation was made immediately available to afford a 16-foot depth in the channel.

The act of March 2, 1907, appropriated \$40,000 for this harbor, and provided that the Secretary of War is authorized to expend any portion of this sum or of the sums heretofore appropriated upon the work of improvement where dock lines have already been established and suitable bulkheads built, but no portion of this or other appropriations shall be used (except for the maintenance of existing channels) where proper dock lines have not been established and suitable bulkheads built along these lines by the city of South Haven or by the riparian owners, and the property lying on the channel side of these dock lines shall have been deeded to the United States free of cost, pursuant to the plan of improvement heretofore adopted.

During the year \$7,976.03 (which does not include payment for dredging under contract during June, 1907) was expended in dredging 81,968 cubic yards so as to afford a 16-foot channel as provided for in the joint resolution of Congress, June 29, 1906, which exhausts the amount made available for the purpose (\$10,000); therefore, unless the conditions precedent to the expenditure of the appropriations, March 3, 1905, and March 2, 1907, are complied with, further operations will be restricted to maintenance of a 12-foot channel. Owing, however, to the possibility of one or more of the riparian owners at the inner ends of the Government piers complying with the prescribed conditions, it is proposed to maintain a channel depth of 16 feet between the piers and 18 feet over the outer bar, so that the requirements of the act of March 2, 1907, on the Government's part may be complied with immediately when such riparian owners have met the requirements of the law on their part.

The total expenditure to June 30, 1907, was \$333,512.33, of which \$187,253.08 was expended for construction and \$146,259.25 for maintenance.

The works are in the condition described in the Annual Report of the Chief of Engineers for 1901, page 3085, except for the additional deterioration due to the lapse of six years. The channel depth exceeds that authorized under the old project.

As is the case with most of the harbors in this vicinity, the principal traffic of South Haven depends upon the fruit crops and the summer resort and excursion travel from Chicago. The business of the harbor has been increasing rapidly.

The money on hand will be expended on maintenance and contingencies until the conditions allowing the continuance of improvement are complied with, and as appropriated will be applied in like manner.

The project is reported to have a material influence in reducing freight rates.

*Entrances and clearances.*

Calendar year.	Number.	Tonnage.
1905 .....	1,223	879,425
1906 .....	688	602,358

Freight carried calendar year—	
1905 -----	tons-- 68, 877
1906 -----	do-- 60, 077
Passengers carried during season of—	
1905 -----	267, 060
1906 -----	279, 886
July 1, 1906, balance unexpended-----	\$44, 957. 81
Amount appropriated by river and harbor act approved March 2, 1907-----	40, 000. 00
	<hr/> 84, 957. 81
June 30, 1907, amount expended during fiscal year, for maintenance of improvement-----	9, 032. 67
July 1, 1907, balance unexpended-----	75, 925. 14
July 1, 1907, outstanding liabilities-----	656. 00
July 1, 1907, balance available-----	<hr/> 75, 269. 14
July 1, 1907, amount covered by uncompleted contracts-----	2, 241. 28
Amount (estimated) required for completion of existing project----	<hr/> <hr/> 248, 000. 00
(See Appendix N N 2.)	

3. *Harbor at Saugatuck, and Kalamazoo River, Michigan.*—Before the work of improvement was begun by the United States, in 1869, this harbor, which is at the mouth of Kalamazoo River, had been improved by local enterprise by the construction of slab piers 200 feet apart, the north pier being 500 feet long and the south pier 1,575 feet. The channel depth varied from 5 to 7 feet. The present project for the old harbor at the mouth of the river was adopted in 1867 and amended in 1869, 1875, and 1882. To June 30, 1906, \$207,785.92 had been expended, of which \$90,231.99 was for construction and \$117,553.93 for maintenance, and as no further expenditures will be made on old harbor, the balance unexpended July 1, 1906, \$9,453.08, was diverted to improvement of new harbor. At present there is a north pier 715 feet long, which is entirely unserviceable; separated from the pier by a long stretch of unprotected bank there is a north revetment, partly destroyed and partly covered by sand. The south pier is 3,863 feet long and is practically ruined. Frequent dredging has been required for maintenance of an 8-foot channel, which rapidly deteriorates. Appropriations since 1882 have been too small to keep the piers in proper repair.

The usual provision for maintenance at the old harbor by dredging was not made last year; inasmuch as the improvement at the new harbor under the existing project was sufficiently advanced to be assured that it could be made available in time for the season's traffic, operations there were pressed forward vigorously.

Persons locally interested had urged the opening of the new channel prior to the revetting of the banks within the piers that had only been built to points about 100 feet shoreward of the shore line; the barrier that separated Kalamazoo River from Lake Michigan was therefore allowed to be cut away and this channel was rendered available to commerce June 30, 1906. The new channel was then deepened by the U. S. dredge *General Gillespie* to 16 feet with a view to continued maintenance by this means; but a storm on October 9 breached the barriers of low beach sand around the inner ends of both piers and carried so much sand into the channel as to preclude

further operations. In anticipation of some such occurrence, allotments amounting to \$14,700 had been granted from the emergency appropriations June 13, 1902, and March 3, 1905, to extend the piers shoreward; the contract could only be placed, however, August 17, 1906, and the work commenced September 14, 1906, and had not progressed far enough when the storm of October 9 occurred to have affected any additional protection. It has been found necessary to repair the pile pier in places and to strengthen it with filling and riprap stone. These matters are explained more in detail in the proper appendix.

The existing project for the new harbor was adopted by the river and harbor act of June 3, 1896. It provides for creating a channel of 12 feet depth and navigable width by dredging the river for a distance of  $1\frac{3}{4}$  miles below Saugatuck, and thence making a new cut from the river to the lake, entering the latter about 3,700 feet below the present mouth at the Saugatuck piers. The original estimate for the work was \$150,000, but authority was granted on May 31, 1900, to increase this to \$250,000. The river and harbor act of March 2, 1907, authorized the maintenance of a harbor channel of sufficient depth to allow the free use of the Government dredge *General Gillespie*, viz, 16 feet.

To June 30, 1907, \$179,968.75 had been expended, \$170,948.11 for construction and \$9,020.64 for maintenance.

When it was decided to do no more work at the old harbor and to render the new harbor navigable in time for the season's traffic, a contract was made under date of March 21, 1906, for cutting away the barrier at and near shore line, 65,000 cubic yards, more or less, being estimated as requiring removal. Work commenced May 3, 1906, and was completed September 6, 1906. There are still portions of the  $1\frac{3}{4}$  miles of river channel between the new entrance and the docks at Saugatuck that require deepening, as much as 4 feet in places, to afford the projected depth of 12 feet to Saugatuck. It is estimated that about 120,000 cubic yards will require removal for the purpose. The project also contemplates revetting the sand banks where the deep excavation was made between river and lake, and this it is estimated will cost about \$50,000, making the total outlay for the improvement the same as originally estimated (\$250,000).

The harbor is near a very prosperous fruit region, and the fruit traffic has been its principal source of business. Saugatuck is but 8 miles south of Holland, with which it is now connected by a trolley road, and about 17 miles north of South Haven. Holland and South Haven both command other sources of business than the fruit traffic alone, and bid fair to increase in importance through the fact that they are termini of important railroad lines.

The Annual Report of the Chief of Engineers for 1896, pages 2741-2743, and House Document No. 192, Fifty-fourth Congress, first session, contain in full the report pertaining to the adopted project for the proposed change in the location of this harbor. The House document contains also a map of the locality.

The money on hand will be expended in continuing improvement, maintenance, and contingencies.

It is reported that as yet the project has had no effect on freight rates, but that reduced charges may be expected upon completion of the improvement.

*Entrances and clearances.*

Calendar year.	Number.	Tonnage.
1905 .....	420	28,494
1906 .....	988	154,628

Total freight carried calendar year—

1905 .....	tons—	8,425
1906 .....	tons—	21,500
July 1, 1906, balance unexpended .....		\$36,788.74
Allotment from appropriation for emergencies, act June 13, 1902 .....		4,700.00
Allotment from appropriation for emergencies, act March 3, 1905 .....		10,000.00
Amount appropriated by river and harbor act approved March 2, 1907 .....		75,000.00
		<u>126,488.74</u>

June 30, 1907, amount expended during fiscal year:

For works of improvement .....	\$23,283.77
For maintenance of improvement .....	9,020.64
	<u>32,304.41</u>

July 1, 1907, balance unexpended .....

94,184.33

July 1, 1907, amount covered by uncompleted contracts .....

9,480.00

(See Appendix N N 3.)

4. *Holland (Black Lake) Harbor, Michigan.*—When improvement was begun in August, 1867, by the United States there existed a narrow channel  $5\frac{1}{2}$  feet deep between piers built of brush and of irregular cribs. These had been constructed by the harbor commissioners of the adjoining town of Holland.

A project was adopted in 1867 and amended in 1873, 1879, 1884, and 1892. From 1867 to 1880 there were built by the United States piers and revetments aggregating 1,854 feet on the north side and 1,691 feet on the south side. Since the latter date there have been no additions to these structures, which were designed to create a 12-foot channel varying in width from 160 feet inside to 213 feet outside, except, in 1889, a length of 160 feet of pile pier on the south side, designed to close a gap in the existing structure. Upon this project there was expended up to March 3, 1899, \$304,217.30, of which \$127,597.50 was for maintenance. Repairs made during recent years have diminished the width inside to 148 feet, but repairs about to be made will widen the channel at its narrowest place from 148 to 198 feet.

A revised project was adopted in the river and harbor act of March 3, 1899, and provided for securing a channel 16 feet deep, protected by piers and revetments 148 feet to 250 feet apart, the estimated cost of completion being \$240,000. From March 3, 1899, the date of adoption of this project, modified by river and harbor act of March 3, 1905, to June 30, 1907, there was expended \$187,177.60, of which \$71,762.52 was for maintenance.

The river and harbor act of March 3, 1905, appropriated \$65,000 and authorized continuing contracts for \$110,000 additional (which has been appropriated), with a proviso that the United States engineer in charge may, subject to the approval of the Chief of Engineers, modify the existing project by the widening of the harbor entrance.

A drawing and description of the plan adopted to carry this proviso into effect may be found in the report of the district officer (pp. 2176-2177, Annual Report of Chief of Engineers for 1905).

A contract was made October 11, 1905, for the completion of the entire improvement for \$144,016.23. Operations commenced April 16, 1906, and are now in progress. The work may be said to be progressing satisfactorily.

Considerable injury to the north entrance pier and revetment near shore line and to the end of the north pier was caused by severe storms in the autumn of 1905, as related at length in the report of the district officer, Appendix N N 5, Report for 1906.

Dredging at the harbor by the U. S. dredge *General Gillespie* was carried on October 11-13 and November 5-16, 1906, and April 4-22, 1907, and restored the channel between the piers to a depth of 15.6 feet and that over the outer bar to 17.3 feet in depth.

The work of repairs to the north pier has been advertised. It is expected that a contract will also be placed for less important repairs to the south pier this season.

Dredging at the harbor will probably be required each year, at any rate until after the completion of the breakwater piers, and a channel 16 feet deep at low water is yet to be secured under the existing project.

This harbor is relatively an important one, being the terminus of one of the lines of the Pere Marquette Railroad Company and of the Grand Rapids, Holland and Chicago Electric Railway, which here connect with a line of steamers, which during the season of navigation and when the condition of the harbor permits, run regularly to Chicago. The passenger business is especially important, but there is also profitable freight traffic, especially during the fruit season. The harbor justifies early improvement in accordance with the requirements of the existing project.

The report upon which the present project is based is published in full in the Annual Report of the Chief of Engineers for 1897, pages 2950, 2951.

Definite information as to the effect of the improvement on freight rates could not be ascertained.

*Entrances and clearances.*

Calendar year.	Number.	Tonnage.
1905 .....	766	864, 514
1906 .....	796	803, 200

Total freight carried calendar year—

1905 .....	tons—	149, 188
1906 .....	do—	159, 986

July 1, 1906, balance unexpended.....	\$137, 675. 14
Amount appropriated by river and harbor act, March 2, 1907.....	138, 452. 00
Amount appropriated by sundry civil act approved March 4, 1907....	40, 000. 00
	<hr/> 316, 127. 14
June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$55, 011. 63
For maintenance of improvement .....	8, 644. 29
	<hr/> 63, 655. 92
July 1, 1907, balance unexpended.....	<hr/> 252, 471. 22
July 1, 1907, amount covered by uncompleted contracts.....	120, 883. 20
(See Appendix N N 4.)	

5. *Grand Haven Harbor, Michigan.*—This harbor is at the mouth of Grand River, the largest river in the State of Michigan. Before any work had been done the natural depth at the mouth of the river varied from 9 to 12 feet, with greater depths in the inner reaches.

In 1857 the Detroit and Milwaukee Railroad Company (Grand Trunk), whose western terminus is at the town of Grand Haven, built a pile pier 3,185 feet long upon the south side of the entrance, and also revetted, by means of close piles, portions of the bank upon the north side of the river. In 1866, when work by the United States was begun, the pile pier had been partly destroyed by fire and by storms. The available depth was 13 feet.

The present project was adopted in 1866 and amended in 1868, 1880, 1890, and 1892. It provides for the construction of parallel piers and revetments 400 feet apart, with the object of creating an entrance channel 18 feet deep. Estimated cost was \$804,366.15. The amendments to the original project did not materially change its original purpose, the changes being principally in the proposed length of the piers and revetments.

To June 30, 1907, there had been expended upon the existing project the sum of \$853,315.26, of which \$542,976.82 was for construction and \$310,338.44 for maintenance.

The result of the above expenditure was the construction and maintenance of 3,538 linear feet of north pier and 5,774 linear feet of south pier, with a channel of variable depth between them maintained by occasional dredging. The piers are now in need of leveling and repairs.

With the money appropriated in the act approved March 2, 1907, it is proposed to put both piers in good condition. Dredging by the U. S. dredge *General Gillespie* was carried on December 21–27, 1906, and there was 11,552 cubic yards removed, so that the soundings May 28–29, 1907, showed a depth on the outer bar of 20 feet and between piers a least available depth of 20 feet.

A central bar persists in forming from year to year beyond the entrance to this fine harbor and seriously impairs its usefulness, even when there is no extraordinary freshet in Grand River; consequently it is fortunate that there is a dredge at hand to undertake relief at any time.

The sum of \$4,300 from the available balance will be reserved for partial payment on an inspection steamer, and the remaining sum will be devoted to repairs and other maintenance.



This harbor has for years been one of considerable importance. It is the western terminus of the Detroit, Grand Haven and Milwaukee branch of the Grand Trunk Railroad, in connection with which is run throughout the year a line of steamers to Milwaukee. In addition there are two lines with regular and frequent scheduled trips to Chicago. All three lines do a large passenger and a very considerable freight business, especially during the season of fair weather.

The latest map of this harbor is found in the Annual Report of the Chief of Engineers for 1890, page 2650.

The effect of the project on freight rates could not be ascertained.

*Entrances and clearances.*

Calendar year.	Number.	Tonnage.
1905 .....	1,412	1,758,807
1906 .....	1,490	1,842,938

Total freight carried calendar year—

1905 .....	tons—	382,373
1906 .....	do—	414,728

July 1, 1906, balance unexpended .....	\$25,199.96
Amount appropriated by river and harbor act approved March 2, 1907 .....	50,000.00

75,199.96

June 30, 1907, amount expended during fiscal year, for maintenance of improvement .....	3,572.15
---	----------

July 1, 1907, balance unexpended .....	71,627.81
July 1, 1907, outstanding liabilities .....	34.00

July 1, 1907, balance available .....	71,593.81
---------------------------------------	-----------

Amount (estimated) required for completion of existing project .....	40,000.00
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(See Appendix N N 5.)

6. *Grand River, Michigan.*—Before any work of improvement was done upon this stream the depth in the crossings over some of the bars did not exceed 2 feet.

Between 1881 and 1886 the sum of \$50,000 was expended in securing, by dredging, narrow channels through these bars with a depth of about 4 feet. No further work was done until 1896, but even then, at the expiration of over ten years, traces of the dredged cuts were still apparent.

The former project, upon which work was begun in May, 1897, was adopted by the river and harbor act of June 3, 1896, and is based upon a report upon examination and survey reprinted in Report of the Chief of Engineers for 1892, pages 2369 to 2395. The project contemplated dredging a channel a distance of 38 miles from Grand Haven to Grand Rapids, with a depth of 10 feet and a width of 100 feet. The project also proposes the use of contraction works wherever necessary to increase the effect of the dredging or to render it more permanent.

The original estimated cost of project adopted in 1896 was \$670,500; but the project may be said to have been modified by act of June 13, 1902, and the cost increased to not less than \$774,000.

The act of March 3, 1905, appropriated \$100,000 for this improvement and modified the former project by adopting the report submitted in House Document No. 216, Fifty-eighth Congress, second session, and by providing that no portion of the money appropriated shall be used in providing a turning basin in the city of Grand Rapids.

The report referred to above recommends, on pages 4 and 5, that a channel of 6 feet depth and 100 feet width be adopted for the improvement. The estimate in the report for a 6-foot channel 100 feet wide from Fulton street, in Grand Rapids, to Grand Haven, Mich., prepared from data furnished by the district officer, is \$430,000, including available plant and funds.

To June 30, 1907, the sum of \$363,508.26 had been expended in dredging 2,048,527 cubic yards of sand, clay, cobblestones, etc., in building 132,410 linear feet of training walls, and in the purchase and maintenance of plant. This sum includes \$24,626.79 expended for maintenance of contraction works and \$625.90 for maintenance of completed 6-foot channel.

Operations during the year have been the extension of the channel of navigable width and 6 feet depth to Fulton Street Bridge, Grand Rapids, Mich., the dredging through other shoals between Wealthy avenue and Bass River by the Government plant, the construction and repair of contraction works, as required, the usual survey work, and extensive rebuilding and repair of plant.

The difficulty of disposing of material dredged by the dipper dredge *Farquhar* made it necessary to provide a conveyor to operate in connection with this dredge, which was accomplished by the conversion of the old dredge *Saginaw* into a conveyor.

The available depths a year ago were stated as follows:

Between Grand Rapids and the mouth of Bass River there is a navigable channel (in some cases only the width of a single dredged cut) with the following depths at extreme low water: For about 14.7 miles, 6 feet; 4.5 miles, 5 to 6 feet; 4.2 miles, less than 5 feet. The least depth found was 3.3 feet. The Grand River Boat Line reports a least depth between Bass River and Grand Haven of 5 feet. At the present time the available depths may be stated thus: Between Grand Rapids and the mouth of Bass River there is a navigable channel (in some cases only the width of a single dredged cut) with the following depths at extreme low water: For about 18.8 miles, 6 feet; 3.2 miles, 5 to 6 feet; 1.4 miles, less than 5 feet.

The contraction works are in fairly good condition. With material on hand it is proposed to build 600 feet of new and repair 30,000 feet of old wall.

The project is naturally one of constant repair and maintenance. High water ordinarily occurs in the early spring, and is from 12 to 18 feet above low water in the neighborhood of Grand Rapids. In the lower part of the river the difference between the high and low stages becomes less, and at the mouth it is inconsiderable.

The commerce involved must still be regarded as indeterminate. A boat line of two new boats (each 219 tonnage and 700 passenger allowance), called the Grand Rapids and Lake Michigan Transportation Company, was put in operation last year between Grand Rapids and Grand Haven. It has provided new warehouse facilities at the foot of Fulton street for the reception and handling of freight,

but can hardly be said to have been operating long enough to positively indicate what will be accomplished. The average daily loads of these boats since they have been in commission this year may be stated at 49 tons freight and 77 passengers.

It is expected to expend the money on hand and as appropriated in continuing improvement and in maintenance.

Definite information as to the effect of the project on freight rates could not be ascertained.

Freight carried, calendar year 1905, 77,217 tons; 1906, 110,395 tons.

July 1, 1906, balance unexpended.....	\$58,438.88	
Deposit by city of Grand Rapids, Mich.....		292.50
Amount appropriated by river and harbor act approved March 2, 1907.....	88,000.00	
		146,731.38
June 30, 1907, amount expended during fiscal year:		
For works of improvement.....	\$36,777.47	
For maintenance of improvement.....	10,086.02	
		46,863.49
July 1, 1907, balance unexpended.....	99,867.89	
July 1, 1907, outstanding liabilities.....		2,015.00
		97,852.89
July 1, 1907, balance available.....		149,000.00
Amount (estimated) required for completion of existing project....		
(See Appendix N N 6.)		

7. *Muskegon Harbor, Michigan.*—This harbor is the outlet of Muskegon River, one of the largest in Michigan, which before emptying into Lake Michigan expands into Muskegon Lake. The channel between the lakes in 1867, before operations were begun by the United States, was 3,000 feet long and about 12 feet deep, except at the entrance, where the depth was 11 feet and the channel fluctuating. By private enterprise the entrance had been protected by converging slab piers.

The present project was adopted in 1866 and amended in 1869, 1873, 1881, 1884, 1890, 1892, and 1902. In its final form it provides for a through channel 20 feet deep and 300 feet wide, protected by piers and revetments. Estimated cost of completion of revised project of 1902, \$380,000. The various changes in the original project did not modify it essentially. They refer merely to the depth of the channel and to the width, length, and direction of the piers.

To June 30, 1902, there was expended upon former modifications of the project the sum of \$526,293.36, of which \$388,218.42 was for construction and \$138,074.94 for maintenance. As a result of the above expenditure there had been constructed a north pier and revetment 2,780 feet long and a south pier and revetment 4,402 feet long, protecting a channel whose width varies from 308 feet at the entrance to 167 feet inside, while the maximum depth which on June 30, 1907, could be carried over the shoalest point in the channel was 17 feet.

From July 1, 1902, to June 30, 1907, there was expended upon the project approved June 13, 1902, the sum of \$124,529.21, of which \$81,280.77 was for construction and \$43,248.44 for maintenance.

Dredging was done between the piers and on the outer bar during the year by the U. S. dredge *General Gillespie*. The dredge operated

December 11 to 19, 1906, and April 1 to 3, 1907, and removed a total of 20,517 cubic yards. Soundings made June 3-6, 1907, showed an available depth of 22 feet over the outer bar and 17 feet between the piers.

A contract was made October 25, 1905, for removing 328 linear feet of cribwork from the portion of the north pier that converges toward the south pier and for replacing it on a line in extension of the north pier parallel to and 300 feet distant from the south pier; for extending this cribwork 1,672 feet toward Muskegon Lake with sheet-pile revetment, and for building 310 linear feet of sheet-pile revetment, station 13+20 to station 16+30, of the south channel protection.

Operations commenced April 17, 1906, but were not completed December 1, 1906, and the time limit was waived. This contract will be completed in July, 1907.

Of the 953 linear feet of the projecting portion of the north pier which will remain after the projected removal of the interior portion 350 feet is 22 to 25 years old and in need of new superstructure. In the south pier 629 linear feet of the old work at and immediately outside of the shore line is in bad condition above water, and authority has been granted for repairs. The rest of the pier is in good condition, with the exception of the places injured by colliding vessels and deficiencies in the stone filling in a number of places.

The funds that were on hand and made available by act approved March 2, 1907, are being applied to repairs of 629 linear feet of the south pier, under contract dated April 17, 1907, and in extending the north revetment to completion, 2,300 feet to Muskegon Lake, soon to be placed under contract; there will then remain 550 feet of south and north pier extension and the dredging of the channel so as to afford 300 feet width and 20 feet depth between piers and revetments, at an estimated cost of \$154,750, to complete the project.

During the season of navigation three lines of steamers regularly use this harbor, which is a terminus of three important railroad lines. Their business is a substantial one, and with increased facilities should grow considerably. A general freight and passenger business is done, and in the summer months is largely augmented by the fruit and the resort traffic. Muskegon Lake itself is a magnificent harbor, 5 miles long and about  $1\frac{1}{2}$  miles wide, with depths varying from 30 to 40 feet. If readily accessible, this would be an excellent harbor of refuge.

The Annual Report of the Chief of Engineers for 1901, pages 3131-3134, and House Document No. 104, Fifty-sixth Congress, second session, contain in full a report upon a preliminary examination of this harbor, in which it is estimated that to secure a channel 300 feet wide and 20 feet deep will cost \$380,000. This project was adopted by the river and harbor act of June 13, 1902. A map showing the harbor and the outlines of the above project accompanies the document mentioned.

It is reported that the project has had a marked influence in providing transportation facilities for commodities at reduced rates.

*Entrances and clearances.*

Calendar year.	Number.	Tonnage.
1905 .....	1,316	955,982
1906 .....	907	599,034

## Total freight carried calendar year—

1905 .....	tons—	238, 721
1906 .....	tons—	136, 340

July 1, 1906, balance unexpended..... \$97, 007. 38  
 Amount appropriated by river and harbor act approved March 2, 1907. 75, 000. 00

172, 007. 38

## June 30, 1907, amount expended during fiscal year:

For works of improvement.....	\$32, 653. 56	
For maintenance of improvement.....	10, 566. 39	
		43, 219. 95

July 1, 1907, balance unexpended..... 128, 787. 43  
 July 1, 1907, outstanding liabilities..... 40. 00

July 1, 1907, balance available..... 128, 747. 43

July 1, 1907, amount covered by uncompleted contracts..... 31, 599. 63  
 Amount (estimated) required for completion of existing project..... 154, 750. 00

(See Appendix N N 7.)

8. *White Lake and Pentwater harbors, Michigan.*—These harbors were formerly carried as separate works, but are now consolidated in consequence of a provision in the river and harbor act of June 13, 1902.

(a) *White Lake Harbor.*—When the present project was adopted, the natural outlet of White Lake, about 3,550 feet north of the present entrance, afforded a channel 5 feet deep and 125 feet wide between slab piers built by local enterprise.

The approved project provided for the abandonment of the old outlet and the creation of a new one, 12 feet deep and 200 feet wide between piers and revetments. This project was adopted in 1866, amended in 1873, 1884, and 1892, the present amended estimated cost being \$353,550. The various amendments to the original project have not altered it materially, as they relate principally to the length of the proposed piers and revetments. The provision in the act approved March 2, 1907, that "the Secretary of War is authorized to dredge the channel at Pentwater to the depth of 16 feet and to dredge the channel at White Lake to sufficient depth to allow the free use of the Government dredge *Gillespie*" may be said to have changed the project to a 16-foot depth and 200 feet width between piers and revetments.

With the available funds it is proposed to deepen the channel to 14 feet under contract, and then to further deepen it to 16 feet with the U. S. dredge *General Gillespie*, so that the accretions by next season will not prevent the United States dredge from operating and again restoring the channel to a 16-foot depth.

To June 30, 1907, there was expended upon the existing project the sum of \$343,165.15, of which \$207,862.44 was for construction and \$135,302.71 for maintenance. This expenditure procured the con-

struction and maintenance of a north pier and revetment 1,715 feet long and a south pier and revetment 1,953 feet long, the natural depth of the channel between them being about 10 feet. Periodical dredging is necessary to secure and maintain a 16-foot channel. Up to June 30, 1907, the maximum draft that could be carried over the shoalest point of the channel was 14 feet.

The works at White Lake are in fair condition, except 150 feet of cribwork in south pier, which is 25 to 26 years old, 754 feet of pile work 22 years old in the south pier, and 515 feet of pile work in the north pier 21 years old, which require new superstructure.

Repairs estimated to cost \$35,850 are needed, and to complete the project 50 feet of north pier extension and 100 feet of south pier extension are required, estimated to cost \$21,720.

Contract dredging carried on June 7 to 30, 1906, restored the channel to a depth of 14 feet and width of 90 feet inside and to a depth of 16 feet for the full width between pier prolongations over the outer bar. There was 13,256 cubic yards removed. Soundings made June 8, 1907, showed depths of 11.8 feet over the outer bar and 13.7 feet between the piers.

The harbor is but 10.5 miles north of Muskegon. Such traffic as there is hardly exceeds in value the annual expenditure necessary to maintain a reliable 16-foot channel.

The last published map of the locality is contained in the Annual Report of the Chief of Engineers for 1884, page 1982.

(b) *Pentwater Harbor*.—Before work was begun at this harbor by the United States there existed an irregular channel 4 feet deep and 75 feet wide between slab piers built by local enterprise.

The existing project, adopted in 1867 and amended in 1873, 1884, and 1892, provides for widening the old entrance to 150 feet and deepening it to 12 feet, the sides being protected by piers and revetments. Estimated cost was \$327,713.40. The amendments to the original project relate merely to the length of the proposed piers and revetments and in no wise enlarge its original scope. The present project, by reason of the provision in the act of March 2, 1907, provides for a channel 16 feet deep and about 150 feet wide, protected by suitable piers and revetments.

To June 30, 1907, there was expended the sum of \$304,464.04, of which \$179,899.10 was for construction and \$124,564.94 for maintenance. The result was a channel 140 to 153 feet wide, whose natural depth is from 9 to 10 feet, protected by a north pier and revetment 2,226 feet long and a south pier and revetment 1,847 feet long. Periodical dredging is necessary to secure the projected depth of 16 feet. The maximum draft which on June 30, 1907, could be carried over the shoalest point in the improved channel was 14.8 feet.

Dredging operations for the temporary restoration of the channel depths at Pentwater Harbor were commenced July 10 and completed August 11, 1906, under contract, and 17,405 cubic yards was removed. Dredging by the United States dredge was done August 27 to September 18, 1906, and April 24 to May 18, 1907, and 59,730 cubic yards was removed.

The condition of the channel, as shown by soundings made June 11-12, 1907, was as follows: Outside, on line of north pier, 17.7 feet; between the piers, 15.8 to 16.5 feet; and on the line of south pier,

12.8 feet. Between the piers, at outer end, 15.2 feet in mid-channel; near shore line, 14.8 feet, and thence to inner lake, 15.2 feet.

It is expected that the United States dredge will return to this harbor before winter and secure at least a depth of 16 feet throughout, so that the winter accretions will not prevent operations next season.

The available funds will be applied to dredging operations. Pier repairs estimated to cost \$10,400 are needed, and to complete the project 200 feet of south pier extension is required, estimated to cost \$26,400.

The commercial importance of this harbor is not great. The important harbor of Ludington is only 12 miles north of Pentwater.

The last published map of this locality is found in the Annual Report of the Chief of Engineers for 1884, page 1980.

The improvement is reported to have materially reduced freight rates by water and secured corresponding reductions in railroad rates.

*Entrances and clearances.*

WHITE LAKE HARBOR.

Calendar year.	Number.	Tonnage.
1906 .....	78	87,388

Total freight carried calendar year 1906.....tons... 400

PENTWATER HARBOR.

Calendar year.	Number.	Tonnage.
1905 .....	900	136,008
1906 .....	2,264	385,896

Total freight carried calendar year—

1905 .....tons... 2,840

1906 .....do... 13,413

WHITE LAKE HARBOR.

July 1, 1906, balance unexpended .....	\$6,956.07
Refundment of overpayment .....	1.30
Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	10,000.00
	16,957.37
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	2,571.22
July 1, 1907, balance unexpended .....	14,386.15
July 1, 1907, outstanding liabilities .....	25.00
July 1, 1907, balance available .....	14,361.15
July 1, 1907, amount covered by uncompleted contracts .....	3,000.00
Amount (estimated) required for completion of existing project.....	21,720.00

## PENTWATER HARBOR.

July 1, 1906, balance unexpended-----	\$12, 265. 90
Amount allotted from appropriation by river and harbor act approved March 2, 1907-----	10, 000. 00
	<hr/> 22, 265. 90
June 30, 1907, amount expended during fiscal year, for maintenance of improvement-----	10, 909. 94
July 1, 1907, balance unexpended-----	11, 355. 96
July 1, 1907, outstanding liabilities-----	20. 00
	<hr/> 11, 335. 96
July 1, 1907, balance available-----	11, 335. 96
Amount (estimated) required for completion of existing project----	26, 400. 00

## CONSOLIDATED.

July 1, 1906, balance unexpended-----	\$19, 221. 97
Refundment of overpayment-----	1. 30
Amount appropriated by river and harbor act approved March 2, 1907-----	20, 000. 00
	<hr/> 39, 223. 27
June 30, 1907, amount expended during fiscal year, for maintenance of improvement-----	13, 481. 16
July 1, 1907, balance unexpended-----	25, 742. 11
July 1, 1907, outstanding liabilities-----	45. 00
	<hr/> 25, 697. 11
July 1, 1907, balance available-----	25, 697. 11
July 1, 1907, amount covered by uncompleted contracts-----	3, 000. 00
	<hr/> 28, 697. 11
Amount (estimated) required for completion of existing project----	48, 120. 00

(See Appendix N N 8.)

9. *Ludington Harbor, Michigan.*—This harbor is the outlet of Pere Marquette River, which expands into Pere Marquette Lake before emptying into Lake Michigan. In 1867, before improvement was begun by the United States, the outlet from Pere Marquette Lake to Lake Michigan had a length of 830 feet, protected by diverging slab piers. The entering depth was 7 to 8 feet.

The former project was adopted in 1867 and modified in 1885, 1889, 1890, and 1899. In its final form, as adopted by the river and harbor act of March 3, 1899, it provided for a through channel 183 to 285 feet wide and 18 feet deep, protected by the requisite piers and revetments. Estimated amount required to complete revised project was \$210,000. It can not be said that the modifications of the original project materially changed it in any regard. The development of the harbor has been progressive, the changes in the original project affecting only the length of the piers and their direction and the depth between them. It may therefore be said that the estimated cost of completion of that project is really the sum of the above amount and that previously expended, or \$591,055.91 in all.

To June 30, 1907, the sum of \$618,027.29 was expended upon the original project and its subsequent modifications. Of the above, \$491,575.79 was expended for construction and \$126,451.50 for maintenance. As a result of the above expenditure, there now exists a reasonably reliable 18-foot channel, protected by piers and revet-



ments. Annual dredging is necessary, however, to maintain a channel of 18 feet in depth and of sufficient width.

The act of March 2, 1907, changed the project by appropriating \$100,000 for the construction of an exterior stilling basin in accordance with report printed in House Document No. 62, Fifty-ninth Congress, first session, and authorizing further expenditure, under continuing contract, of \$739,087, which is yet to be appropriated, for completing the project.

Soundings made April 23-26, 1907, showed the following available depths: Outside, 19.9 feet on the line of the north pier, 20.7 to 22.5 feet in front of the entrance, and 21.8 feet on the line of the south pier; between the piers, 18.6 feet in mid-channel.

To June 30, 1907, the sum of \$159.57 was expended on new project.

This harbor is one terminus of the main line of the Pere Marquette Railroad Company, which operates lines of car ferries from this point to Manitowoc, Wis., and Milwaukee, Wis. A line of passenger and package freight steamers owned by the railroad company also makes regular sailings to Milwaukee. The business done by the car-ferry lines is of enormous and constantly increasing importance in its effect upon freight rates to and from the Northwest. The volume of this business has steadily increased. It is desirable to give to the car-ferry service the same assurance of regularity of schedule as exists in the case of the ordinary railroad lines. At present difficulty is usually experienced in the fall and winter months, due to the narrowing of the channel by a shoal from the north. The car ferries are large and unwieldy and require ample sea room. A narrow channel is therefore impracticable, and to insure safety and regularity to the service dredging should be done as late in the fall as is possible with the type of dredge available. With the United States seagoing hydraulic dredge available, there will be practically no time when dredging can not be done.

It is expected to apply the funds on hand, and those to be appropriated, to continuing improvement, maintenance, and contingencies.

Definite information as to the effect of the improvement on freight rates could not be ascertained.

*Entrances and clearances.*

Calendar year.	Number.	Tonnage.
1905 .....	3,238	4,485,105
1906 .....	3,123	4,424,161

Total freight carried calendar year—

1905.....tons 1,421,558

1906.....do 1,497,424

July 1, 1906, balance unexpended.....	\$49, 385. 34
Amount appropriated by river and harbor act approved March 2, 1907.....	100, 000. 00
	<hr/> 149, 385. 34
June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$159. 57
For maintenance of improvement.....	3, 818. 54
	<hr/> 3, 978. 11
July 1, 1907, balance unexpended.....	145, 407. 23
July 1, 1907, outstanding liabilities.....	37. 00
	<hr/> 145, 370. 23
July 1, 1907, balance available.....	145, 370. 23
Amount (estimated) required for completion of existing project....	<hr/> <hr/> 739, 087. 00
<div style="display: flex; align-items: center;"> <div style="font-size: 3em; margin-right: 10px;">{</div> <div> Amount that can be profitably expended in fiscal year ending June  30, 1909, for works of improvement, in addition to the balance un-  expended July 1, 1907..... </div> <div style="margin-left: 20px;">739, 087. 00</div> </div>	
<div style="display: flex; align-items: center;"> <div style="font-size: 3em; margin-right: 10px;">{</div> <div> Submitted in compliance with requirements of sundry civil act of  June 4, 1897. </div> <div style="margin-left: 20px;"></div> </div>	

(See Appendix N N 9.)

10. *Manistee Harbor, Michigan.*—In 1866, previous to the beginning of work by the United States, the entrance to this harbor was improved by slab piers, 100 feet to 150 feet apart, built by local enterprise, a navigable depth of 7 to 8 feet being thereby maintained.

The project adopted in 1867 and amended in 1871, 1873, 1875, 1884, 1890, and 1892, provides for a channel of navigable width with a depth of 15 feet, extending from Lake Michigan to Manistee Lake, protected by piers and revetments at the entrance. The various modifications of the original project merely extended its limits, changed the proposed length of the piers, and the proposed depth from 12 to 15 feet. Operations have been progressive, and no work under any of the projects not essential to the project in its final form has been done.

To June 30, 1907, there had been expended \$435,332.25, of which \$329,996.18 was for construction and \$105,336.07 for maintenance.

As a result of the above total expenditure to June 30, 1907, there had been built 2,906 linear feet of north and 1,450 linear feet of south pier and revetment, the width between the piers varying between 150 feet inside and 190 feet at the outer end of the south pier, which is 250 feet shorter than the north pier. The piers and revetments are in fair condition, but the portion of the north revetment occupied by the Manistee and Northeastern Railroad Company, referred to in the Annual Report for 1899, page 2940, still remains without repairs, and a portion of the south pier 155 feet in length is some twenty-five years old and requires renewal above water.

The act approved March 2, 1907, changed the project by providing for improvement in accordance with report submitted in House Document No. 511, Fifty-ninth Congress, first session, which contemplates securing a uniform depth of 18 feet, by dredging to a depth of 20 feet, pier extension, revetment, and protection works, at an estimated cost of \$147,488, provided satisfactory pledge is given that certain private and municipal work will be completed within a reasonable time, that land for the improvement will be donated, and that the United States shall be protected from claims for damages which may result from the work.

The through channel has at various times been dredged so as to afford the projected depth of 15 feet. This channel, however, requires periodical dredging. The maximum draft which on June 30, 1907, could be carried through the improved channel was 16 feet. Soundings made June 20-24, 1907, showed a mid-channel depth of 16 feet.

Two of the three bridges that span the channel between Manistee Lake and Lake Michigan, i. e., the channel of Manistee Harbor, have draws that are too narrow for the U. S. dredge *General Gillespie* to pass through them with safety, and as the channel inside the bend near the life-saving station is too narrow for the dredge to turn around, operations by the Government dredge have necessarily been confined to the portion of the channel outside the bend and to the outer bar. Work done by this dredge July 2-3, 1906, removed 6,447 cubic yards from the channel between the piers outside the bend and from the outer bar.

Dredging under contract in the inner reaches was carried on September 6 to October 24, 1906, and 29,250 cubic yards was removed.

Dredging from the inner reaches of the channel is provided for under the contract dated April 3, 1907, for dredging harbors on the east shore of Lake Michigan, and it is expected to expend \$5,000, more or less, as may be found necessary, in putting these reaches in good condition during August and September, 1907.

Reference to reports on preliminary examination and survey, ordered by the river and harbor act approved March 3, 1905, will be found on page 644 of the report for 1906.

The commerce tributary to this harbor is derived principally from the salt and lumber industries. The harbor is also a regular port of call for one line of steamers plying from Chicago to points upon the east shore of Lake Michigan, and a single steamer makes stated trips from Manistee to Milwaukee. There are three railroads running into Manistee, being the Pere Marquette, the Manistee and Grand Rapids, and the Manistee and Northeastern.

The last published map of this locality is found in the Annual Report of the Chief of Engineers for 1890, opposite page 2618.

The funds on hand are to be applied to maintenance.

Definite information as to the effect of the project on freight rates could not be ascertained.

*Entrances and clearances.*

Calendar year.	Number.	Tonnage.
1905 .....	2,312	548,168
1906 .....	2,152	967,758

Total freight carried calendar year—

1905 .....	tons—	469,870
1906 .....	do—	443,931

July 1, 1906, balance unexpended.....	\$22,572. 45
Amount appropriated by river and harbor act approved March 2, 1907.....	25,000. 00
	<hr/> 47,572. 45
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	10,879. 83
	<hr/> 36,692. 62
July 1, 1907, balance unexpended.....	5,000. 00
July 1, 1907, amount covered by uncompleted contracts.....	122,488. 00
Amount (estimated) required for completion of existing project.....	
(See Appendix N N 10.)	

11. *Harbor of refuge at Portage Lake, Manistee County, Mich.*—In 1879, when work was begun by the United States, there was a channel 4 feet deep and 130 feet wide between slab piers built by local enterprise.

The approved project, adopted in 1879 and amended in 1881 and 1890, contemplates the construction of a harbor of refuge, with an entrance from Lake Michigan 356 feet wide and 18 feet deep, protected by piers and revetments. Estimated cost, revised in 1897 and 1899, was \$344,300.

The modifications of the original project have in no way changed its scope, so that essentially the project is to-day as when originally adopted. All expenditures made up to the present time have contributed to the completion of the project in its present form.

To June 30, 1907, there had been expended the sum of \$366,571.71, of which \$254,129.21 was for construction and \$112,442.50 for maintenance. The approved project is now completed only as far as pier construction is concerned.

The harbor structures are in good condition. The north pier, comprising 114 feet of pile work in wing at inner end, 1,235 feet of pile work along channel, and 851 feet of cribwork, has a total length of 2,200 feet and projects 1,210 feet beyond the shore line. The south pier, comprising 1,399 feet of pile work, including 17 feet of wing at east end, and 901 feet of cribwork, has a total length of 2,300 feet and projects 1,210 feet beyond the shore line.

The United States dredge operated at this harbor August 23 and October 24 to November 1, 1906, and removed 16,831 cubic yards.

As shown by soundings made June 27–28, the maximum draft that could be carried from Lake Michigan to Portage Lake, on June 30, 1907, was 17.4 feet.

It is estimated that there are 100,000 cubic yards that should be removed from between the piers to reduce the high banks, and that \$15,000 would be required to complete this work, it having been found impossible to remove the material by use of the United States dredge.

There is little local commerce. The harbor of refuge serves to permit vessels engaged in the general lake commerce, if necessary, to approach more closely the east shore of Lake Michigan, which in this vicinity has hitherto been destitute of harbors readily available in foul weather.

The last published map of this locality is found in the Annual Report of the Chief of Engineers for 1884, page 1974.

Statement of entrances and clearances could not be obtained.

July 1, 1906, balance unexpended.....	\$4, 938. 62
Amount appropriated by river and harbor act approved March 2, 1907.....	10, 000. 00
	<hr/>
June 30, 1907, amount expended during fiscal year, for maintenance of improvement .....	14, 938. 62
	<hr/>
July 1, 1907, balance unexpended .....	2, 010. 33
July 1, 1907, balance unexpended .....	12, 928. 29
July 1, 1907, outstanding liabilities.....	50. 00
	<hr/>
July 1, 1907, balance available.....	12, 878. 29
	<hr/>
Amount (estimated) required for completion of existing project.....	15, 000. 00
(See Appendix N N 11.)	

12. *Arcadia Harbor, Michigan.*—The act of March 3, 1905, appropriated \$6,000 for the improvement of this harbor in accordance with report submitted in House Document No. 194, Fifty-eighth Congress, second session.

While a plan was submitted for rebuilding the piers at a cost of \$90,390 and annual maintenance and dredging at a cost of \$5,200, the plan that was recommended and approved was for maintenance of the present channel by dredging only, at a cost of \$3,000 annually for a period of five years, at the end of which time, if a growth of the commerce is manifested such as to warrant larger expenditures, the plan for radical improvement by reconstruction of the piers could be undertaken. At the time of the survey, September, 1902, the depth was some 12 feet, in a narrow and rather difficult channel, and this depth would be considerably reduced during the usual lowering of the lake surface in the months of October and April, so that only 10 feet could be safely counted on as the navigable depth. The piers terminate at the 10-foot contour.

To June 30, 1907, there had been expended \$4,745.48 for dredging.

Dredging operations under contract dated April 29, 1905, were commenced August 22 and completed September 14, and resulted in restoring a channel 12 feet deep and 60 feet wide from the inner lake to Lake Michigan. The dredged material measured 17,047 cubic yards.

The channel was surveyed June 2-3, 1906, and the available depth between the piers was found to be 10 feet.

Dredging operations were again carried on August 16 to September 4, 1906, under contract dated March 21, 1906, and 8,337 cubic yards removed, restoring a channel 60 feet wide and 12 feet deep.

Soundings made July 1-3, 1907, showed the following available depths: In the outer approach 8.5 feet on the line of the north pier, 9.3 feet in the center, and 10.9 feet on the line of the south pier; between the piers 5.5 feet in the center, but 8 feet close to the outer 500 feet of the north pier and thence in the center of the channel.

Under contract dated April 3, 1907, dredging operations are soon to be undertaken.

What is stated in reporting on White Lake and Pentwater harbors in report for 1906 relative to cost of dredging by contract and by the U. S. dredge *General Gillespie* applies to this harbor, too; consequently, should the plan submitted in House Document No. 194, Fifty-eighth Congress, second session, be fully adopted, it would be in the interests of economy to provide a 16-foot projected depth.

Dredging is the principal cost for maintenance at the harbors on the east shore of Lake Michigan, and a reduction of 67 per cent in this cost is well worth considering, even though an enlarged first cost for original construction might thereby be entailed. With the prevailing draft of freight boats, it may be said in general that the time is probably past when a projected depth of 12 feet, in aid of commerce at any of the harbors, is longer adequate.

The number of tons of various articles shipped and received and the entrances and clearances of vessels from 1894 to 1901, inclusive, are shown on page 576 in Report of Chief of Engineers for 1905.

The money on hand and to be appropriated will be applied to dredging.

Definite information as to the effect of the project on freight rates could not be ascertained.

During the calendar year 1906 there were 945 entrances and clearances, with a tonnage of 80,278. Total freight carried, 2,014 tons.

July 1, 1906, balance unexpended.....	\$2,804.41
Amount appropriated by river and harbor act approved March 2, 1907 .....	6,000.00
	8,804.41
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	1,549.89
July 1, 1907, balance unexpended.....	7,254.52
July 1, 1907, amount covered by uncompleted contracts.....	2,500.00
(See Appendix N N 12.)	

13. *Frankfort Harbor, Michigan.*—In 1867, when the United States began work of improvement at this harbor, which is the outlet to Lake Aux Bees Scies, there existed an outlet about 750 feet north of the present channel, affording a depth of 3 to 4 feet and width of 70 to 80 feet between slab piers, built by local enterprise.

The project, adopted in 1866 and amended in 1868, 1879, and 1892, provided for a new outlet, with channel 12 feet deep and 200 feet wide, protected by piers and revetments. The estimated cost, revised in 1897 in compliance with the river and harbor act of June 3, 1896, to cover the cost of securing a channel 18 feet deep, was \$413,659.85; further revised in 1899 to \$421,938.35. The changes in the original project have been in effect merely extensions, so that the existing project does not differ in kind from the original one. All expenditures may therefore justly be regarded as pertaining to the present project.

To June 30, 1907, there had been expended the sum of \$431,673.52, of which \$321,459.02 was for construction and \$110,214.50 for maintenance. The total expenditure above mentioned has resulted in the creation and maintenance of a channel 18 feet deep, whose natural depth is 12 feet, the width being 200 feet. It is protected by a north pier and revetment 1,900 feet long and a south pier and revetment 1,938 feet long, of which the outer 400 feet was built by the Toledo and Ann Arbor Railroad Company. Dredging from time to time will be required to maintain the depths needed for navigation.

Operations were carried on by the U. S. dredge *General Gillespie*, November 20 to December 5, 1906, 20,831 cubic yards having been removed and the outer bar deepened from 17 to 21.8 feet.

Soundings made July 5-6, 1907, showed a depth of 20.3 feet over the outer bar and 19.4 feet between the piers.

It is expected that dredging operations by United States dredge will again be carried on during the month of August, 1907.

Minor repairs were made to the piers where injured by colliding vessels during the year. The funds on hand are expected to be applied to dredging operations and to repairs, and incidentally to extend the south pier 100 feet while making repairs to that pier.

Practically the entire commerce of this harbor is transacted by the car-ferry lines of the Ann Arbor Railroad, which has its northern terminus at this harbor. These car ferries run to Kewaukee and Marinette, Wis., upon the west shore of Lake Michigan, and form a highly important link in the through commerce between the Northwest and the Atlantic seaboard. The importance of maintaining adequate facilities at Frankfort Harbor is manifest. This can be done with certainty only by repeated radical dredging. Pier extension unaccompanied by thorough dredging will not serve.

The last published map of this harbor is found in the Annual Report of the Chief of Engineers for 1884, page 1973.

Definite information as to the effect of the project on freight rates could not be ascertained.

*Entrances and clearances.*

Calendar year.	Number.	Tonnage.
1905 .....	962	2,027,609
1906 .....	1,633	1,493,089

Total freight carried calendar year—

1905 .....	tons	838,205
1906 .....	do	719,259

July 1, 1906, balance unexpended..... \$24,442.55

Amount appropriated by river and harbor act approved March 2, 1907..... 20,000.00

44,442.55

June 30, 1907, amount expended during fiscal year, for maintenance of improvement..... 3,677.72

July 1, 1907, balance unexpended..... 40,764.83

Amount (estimated) required for completion of existing project..... 13,200.00

(See Appendix N N 13.)

14. *Charlevoix Harbor and entrance to Pine Lake, Michigan.*—In 1868, when the first estimate for improvement was made, the available channel in Pine River between Lake Michigan and Round Lake was 75 feet wide and 2 to 6 feet deep. Up to 1873 the local authorities, with some assistance from the State, had constructed 468 feet of cribwork in the north pier and 80 feet of cribwork in the south pier, and the available depth was 6 feet. The first appropriation by the United States was made in 1876, and actual operations were begun in fiscal year 1878 upon the lower channel; the first appropriation for the upper channel was made in 1882, and actual work begun in 1885. Total estimated cost was \$186,000.

The original project was proposed in 1868, and as amended in 1876 and 1882 provided for a 12-foot channel from Lake Michigan to Round Lake (lower channel), between piers and revetments, 100 to 150 feet apart, and from Round Lake to Pine Lake (upper channel),

between revetments, 83 feet apart. The following provision of the river and harbor act of June 13, 1902, may be said to have extended the scope of the original project: "Improving harbor at Charlevoix and entrance to Pine Lake, Michigan: Continuing improvement, twenty thousand dollars, to be first expended in obtaining a uniform depth of channel from Lake Michigan to Pine Lake." The controlling depth of the lower channel in June, 1902, was 16.3 feet.

The project for this harbor contemplates 200 feet extension of the piers, additional repairs of the piers and revetments, and dredging from time to time, as required.

Up to June 30, 1907, the sum of \$194,170.86 had been expended upon the existing project and its various modifications. The result was a channel 17 feet deep, whose natural depth is 10 feet, protected in its two divisions by a north pier and revetment 2,064 feet long and a south pier and revetment 2,396 feet long. Of the above total expenditure, \$80,205.04 was for construction and \$113,965.82 for maintenance.

Soundings made July 9-11, 1907, showed a depth of 19.8 feet on the outer bar, 16.7 feet in the lower channel, and 16.4 feet in the upper channel; it is expected that the U. S. dredge *General Gillespie* will be operating at this harbor during the month of July, 1907. The operations of this dredge August 9 to 20, 1906, secured a depth of 19 feet over the outer bar, 18 feet in the lower channel, and 17 feet in the upper channel, with the removal of 21,291 cubic yards. Repairs to 600 feet of the north revetment, lower channel, and 321 feet of the south revetment, upper channel, were prosecuted under contract and practically completed during the year. The funds on hand are to be applied to repairs of piers and dredging operations.

The principal traffic tributary to this harbor is furnished by the lumber industry, which has recently been growing greatly in importance. The principal sawmills are situated at Boyne and East Jordan, both at the upper end of Pine Lake, the outlet for which is through both channels. Due to the fact that many of the lumber-carrying vessels do not clear at Charlevoix, the commercial statistics fail to disclose the full traffic, which is, however, known to be considerably over 1,000,000 tons. Charlevoix is also a much-frequented summer resort, and during the summer season two steamboat lines make regular and frequent calls at this harbor. There is in addition a small amount of local traffic. A depth of 17 feet at zero of gauge should be maintained to enable the larger class of vessels to transact their business with economy.

The report upon a survey made with a view to obtaining a 16-foot channel is published in full in the Annual Report of the Chief of Engineers for 1897, pages 2953-2954, and is also printed with a map in House Document No. 144, Fifty-fourth Congress, second session.

Report of the examination authorized by the river and harbor act approved June 13, 1902, has been printed as House Document No. 222, Fifty-eight Congress, second session.

*Entrances and clearances.*

Calendar year.	Number.	Tonnage.
1905 .....	358	182, 899
1906 .....	250	144, 619



## Total freight carried calendar year—

1905-----	tons--	66, 670
1906-----	do--	36, 413
July 1, 1906, balance unexpended-----		\$22, 211. 06
Amount appropriated by river and harbor act approved March 2, 1907-----		20, 000. 00
		<hr/> 42, 211. 06
June 30, 1907, amount expended during fiscal year, for maintenance of improvement-----		<sup>a</sup> 15, 762. 27
July 1, 1907, balance unexpended-----		<hr/> 26, 448. 79
July 1, 1907, amount covered by uncompleted contracts-----		3, 429. 04
Amount (estimated) required for completion of existing project----		23, 750. 00

(See Appendix N N 14.)

15. *Petoskey Harbor, Michigan.*—Before work at this harbor was begun by the United States its landing pier was exposed to winds coming from between west and northwest, and in high gales it was dangerous to attempt a landing.

The present project was adopted in the river and harbor act of August 18, 1894. The approved project provides for constructing a breakwater 600 feet long about 600 feet west of the outer end of the landing pier, and another north of it 500 feet long, or as much longer as may be found necessary to cover the landing from all dangerous seas. Work was begun in 1896. Estimated cost was \$170,000.

To June 30, 1907, there had been expended upon this work \$103,489.82, of which \$101,111.14 was for construction and \$2,378.68 for maintenance. Four hundred feet of the west breakwater and 200 feet of the north breakwater have been built of timber cribs resting upon a stone foundation in deep water and upon natural bottom in shallow water. The remaining 200 feet of the west breakwater has been constructed of riprap stone and bowlders of suitable size. The river and harbor act of June 13, 1902, provided as follows: "Improving harbor at Petoskey, Michigan: Continuing improvement and for maintenance, fifteen thousand dollars, and the Secretary of War is hereby authorized to change or modify existing plans: *Provided*, That the total of expenditure shall not exceed the amount estimated to complete under the existing project." Investigation has shown that the north breakwater is too near the wharf and that the entrance is too narrow. A contract was therefore authorized, after due advertisement, for the removal of the north breakwater and for the extension of the west breakwater, under which operations were in progress that were to have been completed November 1, 1904. Failure to complete on time caused the time limit to be waived.

This contract was completed September 29, 1906.

A contract was made September 18, 1905, for the extension of the breakwater 100 feet. Operations commenced May 16, 1906, and were completed October 13, 1906.

A contract was made June 8, 1907, for the further extension of the breakwater 100 feet. Operations are soon to be commenced under this contract with a fair prospect of completion this season.

<sup>a</sup> Includes \$289.66, Treasury settlement chargeable to maintenance of U. S. dredge *General Gillespie* previous to arrival in Grand Rapids district.

The funds on hand are to be applied to construction, maintenance, and contingencies, and as additional funds are provided it is expected to apply them to construction, maintenance, and contingencies.

Definite information as to the effect of the project on freight rates could not be ascertained.

Statement of entrances and clearances could not be obtained.

July 1, 1906, balance unexpended.....	\$24, 177. 66
Amount appropriated by river and harbor act approved March 2, 1907.....	17, 500. 00
	<hr/> 41, 677. 66
June 30, 1907, amount expended during fiscal year, for works of improvement.....	\$19, 667. 48
	<hr/> 22, 010. 18
July 1, 1907, balance unexpended.....	22, 010. 18
July 1, 1907, amount covered by uncompleted contracts.....	18, 606. 53
Amount (estimated) required for completion of existing project.....	56, 900. 00
(See Appendix N N 15.)	

EXAMINATION MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT  
APPROVED MARCH 3, 1905.

Report dated November 8, 1905, required by the river and harbor act approved March 3, 1905, on *preliminary examination of Pent-water Harbor, Michigan, with a view to obtaining a depth of 16 feet*, was submitted by the district officer and was reviewed by the Board of Engineers for Rivers and Harbors, pursuant to law. The report was transmitted to Congress and is printed in House Document No. 181, Fifty-ninth Congress, second session. A plan is presented for enlarging the existing project to the extent of providing a depth of 16 feet when maintenance dredging in the harbor is undertaken.

IMPROVEMENT OF CERTAIN RIVERS AND HARBORS ON THE  
EASTERN COAST OF MICHIGAN.

This district was in the charge of Maj. Charles Keller, Corps of Engineers, to March 30, 1907, and in the charge of Col. Chas. E. L. B. Davis, Corps of Engineers, since that date. Division engineer, Col. G. J. Lydecker, Corps of Engineers.

1. *Cheboygan Harbor, Michigan.*—This harbor is at the mouth of the Cheboygan River, where there was an available depth of 6 feet in 1870, when the first project for improvement was made, and is the result of improvements commenced in 1871. The original project called for a channel 200 feet wide and 14 feet deep, its sides to be protected by pile revetments and piers, and the estimated cost of the whole work was \$395,335.

Operations under this original project were confined solely to dredging, which was carried to a depth of only 13 feet until 1880, when the first of a series of projects which had for their object the obtaining of a 15-foot channel was submitted, and as a result of the work which was carried on under projects submitted in 1880, 1882, 1887, and 1888 a 15-foot channel was secured from the 15-foot contour in the Straits of Mackinac to the State Road Bridge, having a width of 200 feet from the Michigan Central Railroad dock out into the straits and the available width within the river. A turning

<sup>a</sup> Includes \$2.38 Treasury settlement, chargeable to construction work.

basin, with clear 15 feet depth, was also provided in front of the steamboat docks.

There was expended on the original project \$90,874.42 and \$57,055.02 on the modifications begun in 1880.

Entrance to the channel is marked by a crib 40 feet square, which was built in 1881.

The act of August 18, 1894, directed an estimate of amount required to deepen present channel to a depth of 18 feet. Report was submitted April 2, 1895, and estimated the amount of excavation at 270,000 cubic yards, to cost \$80,000, and contemplated dredging the channel to the full width of 200 feet from the 18-foot curve in the straits to the outer end of the west pier, and inside of that point between lines parallel to and 25 feet from the piers the channel to extend to the State Road Bridge.

Operations under this the present approved project were inaugurated in 1895, expending the balance then on hand, and were continued under the appropriations of 1896, 1899, and 1902, the last dredging being done in 1903, when the channel was carried forward according to the project to within 900 feet of the upper limits of the harbor, which distance still remains to be dredged to complete the project.

The river and harbor act approved March 2, 1907, directed the extension of the improvement from the State Road Bridge to the lock in the Cheboygan River by a channel 8 feet deep and 60 feet wide, the estimated cost of which was \$10,797.60. Borings have been made to determine the nature of the underlying material throughout this stretch of the river.

The amount expended on the work of existing project up to the close of the fiscal year ending June 30, 1907, is \$28,120.24.

The total length of dredged channel from deep water in the Straits of Mackinac to the State Road Bridge is 7,900 feet, 5,900 feet being in the straits. The maximum draft that can be carried over the shoalest part of the channel is 17 feet to within 900 feet of the bridge, and 10 feet for the remainder of the distance. The river is navigable in fact up to its source in Mullet Lake for vessels with a draft of 4 to 5 feet.

The commerce of the harbor is of a general character, consisting mainly of logs, lumber, ties, posts, and pulp wood. It amounted to 459,528 tons during the year 1906. A number of the large lake passenger steamers also stop at this port.

The precise effect of the improvement upon freight rates is difficult of ascertainment, because of the progressive nature of the improvement. The effect has been gradual, and is therefore difficult of ascertainment, but there can be no doubt that during the season of navigation the existence of a deep-water harbor at Cheboygan has had a favorable effect upon the usually high railroad freight rates.

The Report of the Chief of Engineers for 1896 (pp. 2723, 2724) summarizes the history of operations to June 30, 1896, and the Report for 1895 (p. 2824) gives a map of the harbor.

Reports of examinations and surveys are given in the Reports of the Chief of Engineers, as follows: 1870, page 44; 1871, pages 183-186; 1880, page 2035; 1895, page 2825; 1897, page 2577; 1900, page 4012, and reference on page 664, report of 1906.

*Receipts and shipments by vessel.*

Calendar year.	Received.	Shipped.	Calendar year.	Received.	Shipped.
	<i>Tons.</i>	<i>Tons.</i>		<i>Tons.</i>	<i>Tons.</i>
1893.....	155, 898	285, 189	1900 .....	44, 237	59, 536
1894.....	76, 554	227, 346	1901 .....	161, 771	252, 727
1895.....	110, 062	216, 868	1902 .....	177, 231	292, 553
1896.....	163, 362	362, 011	1903 .....	33, 723	259, 224
1897.....	147, 255	293, 161	1904 .....	24, 815	106, 461
1898.....	366, 332	334, 636	1905 .....	419, 171	114, 188
1899.....	152, 689	352, 214	1906 .....	318, 442	141, 086

July 1, 1906, balance unexpended..... \$8, 309. 14  
 Amount appropriated by river and harbor act approved March 2, 1907..... 15, 000. 00

23, 309. 14  
 June 30, 1907, amount expended during fiscal year, for maintenance  
 of improvement..... 858. 82

July 1, 1907, balance unexpended..... 22, 450. 32

Amount (estimated) required for completion of existing project..... 5, 000. 00

(See Appendix O O 1.)

2. *Alpena Harbor (Thunder Bay River), Michigan.*—The original depth of water over the bar at the mouth of the Thunder Bay River was only 7 feet. Local enterprise had secured a narrow channel 12 feet deep through the bar before work was undertaken by the Government in 1877, when, under the original project for the improvement of this harbor, act of August 14, 1876, estimated cost \$1,764, a channel 13 feet deep and 200 feet wide was secured at a cost of \$4,390.48. Shoaling having occurred, in 1882 \$15,000 was appropriated for redredging the channel and the project was modified so as to make the available depth 14 feet. The work was completed the following year at a cost of \$10,500, and the balance of the \$15,000 was expended in 1889 in redredging to 14 feet across the bar and 13 feet upstream. The total cost of the 1882 project was \$14,498.22.

In 1890 the project was again modified so as to propose a channel depth of 16 feet and the extension of the improvement up the river about a mile to the vicinity of the dam across the river at that point, with widths varying as follows: 200 feet at the 16-foot contour in Thunder Bay, thence tapering to 100 feet at the light-house crib, thence 100 feet to the Second Street Drawbridge, thence 75 feet to the Minor Lumber Company's wharf, thence 50 feet to the upstream limit of the channel improvement, the estimated cost being \$36,087.48. This project was completed in 1893. The channel was redredged in 1899.

The amount expended on the work of existing (1890) project to the close of the fiscal year ending June 30, 1907, is \$31,173.90, of which amount \$9,873.43 has been applied to maintenance.

It is proposed to apply the available balance to the restoration of the depth of that part of the channel inside the light-house crib.

The total length of dredged channel is 6,550 feet, a channel 2,250 feet long and 100 to 200 feet wide having been secured in Thunder Bay, and 4,300 feet long in the river, with widths varying from 100

feet at the light-house crib to 50 feet at the upstream limit of the improved channel. The maximum draft that can be carried over the shoalest part of the channel June 30, 1907, is 14 feet. The river is navigable in fact to the upper limit of the improvement only, farther navigation being interrupted by the dam across the river at that point.

The commerce of the harbor consists mainly of lumber, cement, coal, cedar posts and ties, hay and feed, and general merchandise, and amounted to a total of 249,426 tons during the year 1906, valued approximately at \$3,018,894.

The effect of the improvement upon freight rates has been very beneficial, as it can safely be said that freight and passenger rates have decreased almost one-half since the improvements were made.

A detailed report of operations to that date will be found in the Annual Report of the Chief of Engineers for 1891, pages 2765-2770, and a map showing the locality in the Annual Report for 1889, page 2290.

Reports of examinations and surveys are found in the following Reports of the Chief of Engineers: 1871, pages 158-159, and for 1876, page 106.

*Receipts and shipments by vessel.*

Calendar year.	Received.	Shipped.	Calendar year.	Received.	Shipped.
	<i>Tons.</i>	<i>Tons.</i>		<i>Tons.</i>	<i>Tons.</i>
1893.....	51,600	308,988	1900.....	51,653	263,762
1894.....	102,700	363,281	1901.....	62,131	169,442
1895.....	35,957	269,203	1902.....	60,213	198,201
1896.....	94,067	255,687	1903.....	69,721	158,222
1897.....	78,378	233,161	1904.....	51,722	150,381
1898.....	60,300	236,075	1905.....	78,331	200,785
1899.....	27,888	197,725	1906.....	78,241	171,185

July 1, 1906, balance unexpended..... \$1,467. 31  
 Amount appropriated by river and harbor act approved March 2, 1907..... 4,000. 00

5,467. 31

June 30, 1907, amount expended during fiscal year, for maintenance of improvement..... 29. 91

July 1, 1907, balance unexpended..... 5,437. 40

(See Appendix O O 2.)

3. *Saginaw River, Michigan.*—The Saginaw River has a length of about 22 miles, and is formed by the confluence of the Tittabawassee and Shiawassee rivers. Prior to improvement, the entrance to the river was obstructed by a bar in Saginaw Bay, having a minimum depth of about 9 feet. Between the mouth and Bay City the depth varied from 15 to 30 feet. Thence to the head of the river the channel was obstructed by a number of bars, having 7 feet of water.

The original project for the improvement of this river was made in 1866, and contemplated a straight channel 195 feet wide and 12 feet deep across the bar at the mouth. This was completed in 1869, \$104,500 having been appropriated up to that time. In 1874 a project for improving the river above Bay City was adopted. It included dredging a 10-foot channel across the bars at East Saginaw

and Carrollton, and the construction of a pile revetment at the latter place. Later, similar improvements at Zilwaukee bar, New York Works bar, and Willow Island were added.

In 1882 a scheme of improvement covering the entire river was adopted. It called for a channel 200 feet wide and 14 feet deep from Saginaw Bay to and along the front of Bay City, and thence a channel of same width, 12 feet deep, to the upper limits of the city of Saginaw. By the river and harbor act of August 5, 1886, the improvement of the west channel along West Bay City was also added to the project.

The estimated cost of this project was \$446,000, which, added to the estimated cost of the several preceding projects (\$294,378), gives \$740,378 as the estimated cost for the whole improvement. These estimates concerned the question of original cost only, and took no note of maintenance, which, in a stream of this character, is a matter of great and constant expense, and in the absence of appropriations specifically applicable thereto must be an annual tax of no small magnitude on the successive appropriations for construction. The sum total of appropriations that will have to be made before the work can be completed must therefore largely exceed the original estimates for construction only.

The total expenditure to June 30, 1907, was \$836,627.84, and the result has been to obtain only a narrow through channel, which has little permanence, and almost constant dredging is needed to maintain it. This has been the case especially as respects the section of the river from Bay City to Saginaw, and in a somewhat less degree through the bar at the river's mouth in Saginaw Bay. In order to restore and maintain the channel as required in the interests of navigation, the work of dredging should be constant, as a depth of 12 and 14 feet, respectively, and a minimum width of 150 to 200 feet can only be preserved by dredging the bars which are liable to be formed by each freshet.

During the past fiscal year work of restoring the project depths through shoals that had formed in the river has been in progress under a contract with James Davidson, of West Bay City, Mich., at 25 cents per cubic yard, scow measurement. As a result of the work done under this contract, a 14-foot channel was provided to and along the front of Bay City, and a 12-foot channel dredged through the shoals existing between Bay City and the head of the Carrollton channel.

The amount expended on the existing project to June 30, 1907, is \$617,627.84. In the past no attempt has been made to separate the cost of maintenance from that of original improvement, so that it is impossible now to separate these costs. All work during the past year has been work of maintenance.

The available balance will be applied to maintenance and extension of the entire existing improvement, experience having shown that deterioration may be expected at practically all dredged cuts.

As a result of the expenditures herein reported, a channel width suitable for navigation not less than 12 feet deep at and below Bay City, and not less than 10 feet in the river above that point, has been secured. To insure the greater depths called for in the approved project requires, however, that dredging be done periodically at

relatively short intervals. Saginaw River is navigable for a distance of 22 miles from the mouth.

The volume of commerce benefited by the improvement has been decreasing, having fallen from 1,945,033 tons in 1901 to 293,105 tons in 1906, this being due to the decrease in the lumber trade in the Saginaw Valley. The value of the commerce carried in 1906 is approximately \$2,248,025, and it consisted mainly of lumber, coal, and salt.

The precise effect of the improvement upon freight rates can not be stated. It is undoubted, however, that freight rates, both to Bay City and Saginaw, have been materially lowered by the existence of the improved channel.

More extended information can be found in the Annual Reports of the Chief of Engineers for 1883, pages 1858-1868; 1885, pages 2138-2150 (with maps); 1890, pages 2724-2729, and 1892, pages 2454-2464.

Reports of examinations and surveys are given in the Reports of the Chief of Engineers, as follows: 1866, page 59; 1867, page 146; 1872, page 207; 1874, pages 206-209; 1875, page 289; 1878, page 1234; 1882, page 2332; 1893, page 2928; 1894, page 2244; 1895, page 2829; 1898, pages 2579, 2600, and 2604.

*Receipts and shipments by vessel.*

Calendar year.	Received.	Shipped.	Calendar year.	Received.	Shipped.
	<i>Tons.</i>	<i>Tons.</i>		<i>Tons.</i>	<i>Tons.</i>
1893.....	651,163	1,069,298	1900.....	482,253	402,827
1894.....		1,108,807	1901.....	1,250,292	694,741
1895.....	391,751	347,146	1902.....	1,012,620	106,409
1896.....	471,106	240,496	1903.....	359,779	17,999
1897.....	995,960	354,860	1904.....	264,066	13,010
1898.....	1,126,891	364,561	1905.....	227,226	14,161
1899.....	728,629	811,547	1906.....	274,245	18,860

July 1, 1906, balance unexpended.....	\$46,635. 89
Amount appropriated by river and harbor act approved March 2, 1907.....	75,000. 00

121,635. 89

June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	15,511. 89
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July 1, 1907, balance unexpended.....	106,124. 00
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(See Appendix O O 3.)

4. *Sebewaing River, Michigan.*—The original channel from Saginaw Bay to the mouth of Sebewaing River had an available depth of scant 4 feet. The first improvement was made in 1875, under the original project of that year, when a narrow channel 6 feet deep was dredged from the 6-foot curve in Saginaw Bay to the mouth of the river, and some dredging was also done within the river itself, by which it was straightened and deepened to 6 feet, at a cost of \$8,000.

The project was modified in 1880 and \$7,000 appropriated for deepening the channel to 7 feet, the work being done in 1880-81.

The existing project provides for dredging the entrance channel to a width of 100 feet and depth of 8 feet below the datum plane of the survey of 1895; the length of dredged channel to be about 15,000 feet; estimated cost, \$37,000; was adopted in 1896, but no work was done until the appropriation of March 3, 1899, became available. Contract was made in 1899 to do the work, which was finished, as far as available funds permitted, September 9, 1903, and resulted in securing a channel of the required length and depth but with widths varying from 70 to 90 feet throughout the distance covered. The amount expended on this improvement was \$35,573.45.

A small shoal which had formed in the channel just beyond the mouth of the river was removed in May, 1904, and in the fall of 1905 the channel at the mouth of the river was redredged a distance of 2,200 feet, 50 feet wide and 8 feet deep, and a cut about 30 feet wide was continued a farther distance upstream of 1,100 feet to the boat landing opposite the old channel bed. The latter was closed by a pile dam and revetment 150 feet long.

The amount expended on the work of existing project to the close of the fiscal year ending June 30, 1907, is \$41,255.86, of which amount \$5,682.41 has been applied to maintenance.

The available balance is required to maintain the existing improvement.

The maximum draft that can be carried June 30, 1907, at mean low water, over the shoalest part of the locality, is 7 feet. The river is navigable to the docks at Sebewaing.

The commerce affected by the improvement amounted in 1906 to 9,815 tons, valued approximately at \$195,000, and consisted mainly of lumber, farm products, and coal. The effect of the project upon freight rates can not be definitely stated, but information received from the largest local merchant is to the effect that the improvement has had a favorable effect upon freight rates generally and that the prospect is for an increased use of the harbor.

The commercial statistics for the years 1905 and 1906, however, show a very material falling off from the totals of previous years, a change which is more probably due to errors in filing statistics for former years than an actual diminution of the traffic. The expenditures necessary for improvement are deemed to be out of all proportion to the amount of commerce involved, and for this reason this river is not regarded as worthy of continued improvement. Any expenditure made hereafter should be for maintenance only, and for the present such expenditure should not exceed \$2,000 a year. It is not believed that much good can be accomplished by a channel 8 feet deep, and there is not enough commerce to warrant the expenditure needed in creating a channel of greater depth.

A map of the locality is given in the Annual Report of the Chief of Engineers for 1903, at page 1988.

Reports of examinations and surveys are given in the following Reports of the Chief of Engineers: 1873, pages 306, 307; 1875, page 290; 1879, page 170; 1880, page 2044; 1891, page 2804; 1893, page 2951, and 1895, page 2743.



*Receipts and shipments, by vessel.*

Calendar year.	Received.	Shipped.	Calendar year.	Received.	Shipped.
	<i>Tons.</i>	<i>Tons.</i>		<i>Tons.</i>	<i>Tons.</i>
1896.....	48,700	123,274	1902.....	83,500	44,750
1897.....	50,481	139,987	1903.....	14,405	29,910
1898.....	14,820	151,085	1904.....	14,770	30,500
1899.....	13,088	127,450	1905.....	4,700	4,350
1900.....	24,200	118,225	1906.....	5,740	4,075
1901.....	17,625	77,998			

July 1, 1906, balance unexpended..... \$941.44  
Amount appropriated by river and harbor act approved March 2, 1907.. 2,000.00

2,941.44

June 30, 1907, amount expended during fiscal year, for maintenance of improvement..... 197.30

July 1, 1907, balance unexpended..... 2,744.14

(See Appendix O O 4.)

5. *Harbor of refuge at Harbor Beach, Lake Huron, Michigan.*—The site for this harbor, selected in 1872 after careful consideration by a Board of Engineer officers, is on the west shore of Lake Huron, 60 miles north of its outlet into the St. Clair River, and the artificial harbor built there since then is the only safe refuge on that coast from the foot of the lake to Tawas Bay, 115 miles above.

The work of construction was commenced in 1873 under a project providing for three separate piers or breakwaters of cribwork filled with stone, so located as to shelter a water area of some 650 acres on the north, northwest, and west sides, and for deepening this area by dredging where necessary. The estimated cost of the breakwaters was \$1,452,550, and they were completed in 1885 at a cost of about \$975,000.

The river and harbor act of March 3, 1899, provided for commencing the work of rebuilding the superstructure of the main pier in concrete and authorized the work to be inaugurated under the continuing-contract system to the extent of \$200,000. It was not, however, until 1903 that a definite project for doing the work was decided upon, and the first contract was let in August of that year. The work was begun in June, 1904, and has continued up to the present time, 2,521 linear feet of concrete superstructure having been completed at the close of the present fiscal year.

A second contract for reconstruction of part of the superstructure of the main pier, under advertisement and specifications dated May 11, 1905, was made with the Murray Company, of Saginaw, Mich., on August 22, 1905. Up to April 19, 1906, nothing whatever had been done upon this contract, and on that date the Murray Company surrendered the contract. Under authority from the Chief of Engineers on April 23, 1906, contract was entered into with Messrs. Hugo & Tims, of Duluth, Minn., the contractors for the first section of the concrete superstructure covering the work included in the above-mentioned contract with the Murray Company, upon the basis of the unit prices bid by the latter firm. Operations under this contract were begun in May, 1906.

The existing project for the improvement of the harbor, adopted by the river and harbor act of March 3, 1899, provides for the reconstruction in permanent materials of part of the superstructure of the main pier, but no estimate of cost covering this work has up to date been included in any annual report.

The total amount expended to the close of the fiscal year ending June 30, 1907, is \$1,653,105.19, of which about \$975,000 was applied to the first cost of the sheltering breakwaters, which were completed in 1885. Of the \$678,105.19 remaining, \$321,809.83 has been applied to payments in connection with the work of building concrete superstructure, leaving \$356,295.36 which has been applied to maintenance, this including the keeping of the piers in repair, dredging within the harbor, control and berthing of vessels entering the harbor for shelter, and engineering supervision and general office expenses.

The available balance will be applied to payment for work done under the contracts above referred to and to cover the cost of the necessary supervision of the harbor during the ensuing fiscal year; also to such repairs as may become necessary.

As a result of the expenditures made upon this harbor, there has been created an artificial harbor of refuge, which has been used for shelter during the past year by 938 vessels, with a total tonnage of 773,231 tons. The grand total of vessels that have found shelter from 1877 to 1906, inclusive, is 35,474, the tonnage of which aggregated 15,259,876. The vessels sheltered in 1877 averaged 289 tons each and those during the year 1906, 809 tons. The maximum draft that can be carried into the harbor through the main entrance, making allowance for the effect of moderate seas, is between 19 and 20 feet, and vessels having this draft may safely lie inside the main pier.

More extended information can be found in the Annual Reports of the Chief of Engineers for the following years: 1873, pages 292-298; 1877, pages 925-932 (with map); 1879, pages 1645-1648 (with map); 1881, pages 2270-2275; 1882, pages 2369-2372; 1885, pages 2151-2157; 1886, pages 1829-1836.

Reports of examinations and surveys are given in the following Reports of the Chief of Engineers: 1870, page 46; 1871, page 44; 1872, pages 209, 211, and 218; 1895, page 2832; 1896, page 2730; 1897, page 3016; and reference on page 664, report of 1906.

July 1, 1906, balance unexpended.....	\$290, 781. 62
Amount appropriated by river and harbor act approved March 2, 1907.....	150, 000. 00
	<hr/> 440, 781. 62
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	177, 519. 60
July 1, 1907, balance unexpended.....	263, 262. 02
July 1, 1907, outstanding liabilities.....	21, 800. 00
	<hr/> 241, 462. 02
July 1, 1907, balance available.....	210, 426. 59
(See Appendix O O 5.)	

6. *Mouth of Black River, Rouge River, and Monroe Harbor, Michigan.*—(a) *Mouth of Black River.*—An extensive bar and shoal formerly existed in the St. Clair River adjoining the mouth of the

Black. The bar lay close to the American side and obstructed approach to the Port Huron docks, while the shoal, forming a "middle ground" nearly 50 acres in extent, crowded the main channel in a sharp curve close to the Canadian shore.

The original project submitted in 1871 contemplated the removal of this bar and the middle ground to a depth of 15 feet at an estimated cost of \$67,320. The work was begun in 1872 and completed in 1878 at a cost of \$56,500.

The present project contemplates dredging to a uniform depth of 16 feet along the dock front of Port Huron from the 16-foot curve above to the same curve below the mouth of the river. Work was begun in May, 1889, and finished in 1892, when, finding that a small balance would be left, authority was received to deepen the outer border of the shoal adjacent to the main channel to 18 feet and the work was done. The amount expended on this work was \$29,349. Operations since this time have been confined to maintenance, the area having been redredged to 16 feet in 1897.

The work that has been in progress at this locality during the past fiscal year has consisted in removing the shoal that had formed in the St. Clair River adjoining the mouth of the Black River and within the mouth of the Black River itself. This work was done under a contract with the Muir-O'Sullivan Dredge and Dock Company, of Port Huron, Mich., at 15½ cents per cubic yard. The work was still in progress at the close of the year, 14,405 cubic yards having been removed at a cost of \$2,232.78.

The amount expended on work of existing project to close of year ending June 30, 1907, is \$37,573.15, of which \$8,224.57 has been applied to maintenance.

The available balance will be applied to dredging such portion of the bar as may prove to be obstructive to navigation.

As a result of the work heretofore done through navigation for vessels of moderate draft has been greatly facilitated and entrance into the Black River proper has been rendered possible for this same class of vessels. This, it is believed, has resulted in a reduction of freight rates, the extent of which could not be ascertained.

Reports of examinations and surveys are given in the following Reports of the Chief of Engineers: 1871, pages 177-180; 1887, page 2279; 1899, page 2992; 1900, page 3986.

July 1, 1906, balance unexpended.....	\$5, 613. 86
Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	1, 000. 00
	<hr/> 6, 613. 86
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	187. 01
	<hr/>
July 1, 1907, balance unexpended.....	6, 426. 85
July 1, 1907, outstanding liabilities.....	175. 00
	<hr/>
July 1, 1907, balance available.....	6, 251. 85
July 1, 1907, amount covered by uncompleted contracts.....	4, 030. 00

(b) *Rouge River*.—This stream originally had a channel depth of from 10 to 17 feet from its mouth to where the Wabash Railroad bridge crosses it, a distance of about 3 miles.

Under the provisions of the river and harbor act of August 5, 1886, a survey of the river was made and a project, dated August 25, 1888, prepared for securing a channel depth of 16 feet with a width of 240 feet for a distance of 800 feet from the mouth and thence with a width of 100 feet to the Wabash bridge. The estimated cost was \$31,690.39. The work of improvement was commenced in 1888 and completed in November, 1892, at a cost of \$30,272.79.

By joint resolution approved April 11, 1898, Congress authorized an extension of the improvement, with depth of 13 feet, up to the Maples road, a distance of about  $1\frac{1}{2}$  miles above the Wabash Railroad bridge, limiting the expenditure to \$5,000. The river was dredged in 1900, the channel being made 50 feet wide.

The project for this river was modified by act of March 2, 1907, so as to provide an increase in depth from 16 feet to 21 feet between the mouth of the river and the first bridge, a distance of about 1,400 feet; estimated cost, \$3,575. The work of securing this depth will begin shortly after the close of the fiscal year under a contract at 16 cents per cubic yard.

During July and August, 1903, a depth of 21 feet was secured for a portion of the width of the channel for a short distance from the mouth of the river, by dredging done at the expense of the Detroit Iron and Steel Company, to enable loaded vessels to reach its wharf, which is located at the mouth of the river.

During the past fiscal year work of restoring the channel depth of 16 feet through the bars that had formed in the river below the Wabash Railroad bridge was in progress under contract at 13 $\frac{1}{2}$  cents per cubic yard. Operations were commenced May 21, 1906, and were discontinued July 28, 1906, a total of 37,665 cubic yards being removed.

The amount expended on the work of existing project as amended to the close of the fiscal year ending June 30, 1907, is \$57,327.21, of which \$10,888.80 has been applied to maintenance of improvement.

As a result of the work of improvement done on this river, a channel with a depth of 16 feet has been secured from the mouth of the river to the Wabash bridge, with a width of 240 feet for the first 800 feet and 100 feet the remaining distance, and with a depth of 13 feet and width of 50 feet from the bridge to the Maples road. The maximum draft that can be carried June 30, 1907, from the mouth to the Michigan Central Railroad bridge is 15 feet, between the Michigan Central and Wabash Railroad bridges 13 feet, and from the Wabash bridge to the Maples road 11 feet. The river is navigable for vessels of light draft as far as the town of Dearborn, 15 miles above the mouth.

The available balance will be applied to maintaining the channel depths below the Wabash bridge and to widening, so far as may prove necessary, the channel above that bridge.

The receipts and shipments by vessel during the year 1906 amounted to 234,861 tons, of which 121,610 tons was iron ore, 77,246 tons lumber, and 22,500 tons pulp wood. The value of this commerce is about \$1,612,485.

As a result of the improvement the area available for manufacturing plants in the vicinity of Detroit has been greatly extended, and these plants have been enabled to receive the raw materials

which they use without transfer or transshipment. As a consequence the cost of the raw materials has been greatly reduced.

The channel banks of this river are low and ill-defined, and as not only the banks, but also the bed, are composed of soft material, deterioration of the dredged channel is very rapid. While therefore the growing importance of the industries which rely upon the use of this channel renders it desirable that funds for periodical dredging be provided, it also becomes necessary to demand that the owners of the riparian property, whose value is greatly enhanced by the improvement, shall be called upon to construct proper sand-tight docks. Without such provision recent experience shows that the channel is no sooner dredged than it at once begins to fill up from the material sucked into the channel by the propellers of passing vessels. While therefore the extent of the commerce demands additional depth in the lower portion of the channel, future appropriations should be coupled with the condition that no expenditure be made by the United States until the channel banks within the limits of the improvement have been properly docked.

The effect of the improvement has been to reduce freight rates 30 to 50 per cent for firms actually using dockage on the river.

Reference to report on examination ordered by the river and harbor act of March 3, 1905, will be found on page 664 of 1906 report. More extended information may be found in Annual Reports for 1890 (pp. 2747-2749); 1899 (p. 3013); 1901 (p. 3155). Reports on examinations and surveys, report for 1887 (p. 2275); 1898 (p. 2605).

*Receipts and shipments by vessel, Rouge River.*

Calendar year.	Received.	Shipped.	Calendar year.	Received.	Shipped.
	<i>Tons.</i>	<i>Tons.</i>		<i>Tons.</i>	<i>Tons.</i>
1893.....	73, 732		1900.....	119, 712	4, 600
1894.....	47, 106		1901.....	105, 533	782
1895.....	113, 066	1, 024	1902.....	56, 701	10, 000
1896.....	120, 590	2, 905	1903.....	125, 272	10, 000
1897.....	115, 987	9, 386	1904.....	242, 361	6, 898
1898.....	117, 486	10, 259	1905.....	284, 140	
1899.....	92, 631	763	1906.....	229, 861	5, 000

July 1, 1906, balance unexpended.....	\$6, 993. 13
Amount allotted from appropriation by river and harbor act approved	
March 2, 1907.....	7, 000. 00
	13, 993. 13
June 30, 1907, amount expended during fiscal year, for maintenance of	
improvement.....	4, 630. 34
July 1, 1907, balance unexpended.....	9, 362. 79
July 1, 1907, amount covered by uncompleted contracts.....	3, 520. 00

(c) *Monroe Harbor.*—The harbor of Monroe, Mich., is within the mouth of the Raisin River at the western extremity of Lake Erie. In its natural condition the river flowed into the lake through several ponds and winding creeks. The depth of water at the deepest mouth of the river in its natural condition did not exceed 5 feet.

The original project for the improvement of Monroe Harbor was adopted in 1834. It had for its object to dredge a new and direct channel 100 feet wide and 10 feet deep from the lake across the marsh, a distance of 4,000 feet, to the portion of the river ordinarily used as a harbor; the protection of the entrance into the lake by parallel piers, 726 feet long and 20 feet wide, extending outward to a depth of 10 feet in the lake, and the protection of the sides of the canal by a revetment. The estimated cost of the work, exclusive of dredging machine, was \$55,885. The work was practically completed in 1845, a depth of 9 feet being obtained to a point just below the docks at Monroe. Subsequently the city of Monroe further improved the river channel by cutting a canal about 1,300 feet long, 100 feet wide, and with a depth of from 13 to 16 feet, across a bend of the river. Subsequent operations consisted in repairing and extending the piers, repairing the canal revetment, and in keeping the channel dredged to the required depth. The river and harbor act of June 3, 1896, appropriated \$5,000 for dredging the channel. This amount was applied to dredging a channel 150 feet wide and 14 feet deep from the outer end of the piers to a depth of 14 feet in the lake, a distance of about 1,800 feet. Again, in 1899, \$5,000 was appropriated for dredging. The work under this appropriation was completed in 1901 and left a channel 200 feet wide and 13 feet deep, extending to deep water in the lake.

The total amount expended on this work up to the close of the fiscal year ending June 30, 1907, is \$254,805.35, of which \$110,000 was applied under the original project. It is impossible to separate the portion of this total which has been applied to maintenance. During recent years practically all expenditures have been made for that purpose.

The channel, beginning at the outer end, consists of the United States canal, 4,000 feet long, with an available depth of about 14 feet. Three thousand feet farther up the river the Monroe city ship canal begins. This has a length of 1,600 feet and a depth of 12 to 16 feet. From the upper end of this canal to the city wharves is 2,600 feet, with a depth of 10 to 12 feet. The stream is navigable from the lake to the docks at Monroe only, a distance of 2 miles.

This harbor can not accommodate the larger class of vessels used upon the lakes, and its commerce is not large, amounting in the year 1906 to 11,388 tons, valued at \$17,000. Of this amount 10,280 tons was sand, the major portion of the balance consisting of coal and fish. The harbor is mainly used by excursion boats bringing passengers during the summer months.

The nature of the commerce is such as to limit the effect of the improvement upon freight rates, largely because the smaller class of vessels can not carry freight with the same degree of economy as those of a larger size. It would seem, however, that the harbor is adapted to local needs.

The Annual Report of the Chief of Engineers for 1880, pages 2083 to 2091, gives a detailed history of the operations up to that time.

Reports of examinations and surveys are given in the following Reports of the Chief of Engineers: 1866, page 29; 1868, page 145; 1872, pages 237-239; 1889, page 2338; 1893, page 3048; 1898, page 2689, and 1900, page 4020.

July 1, 1906, balance unexpended.....	\$2, 859. 92
Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	4, 000. 00
	<hr/> 6, 859. 92
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	650. 00
	<hr/> 6, 209. 92

## CONSOLIDATED.

July 1, 1906, balance unexpended.....	\$15, 466. 91
Amount appropriated by river and harbor act approved March 2, 1907.....	12, 000. 00
	<hr/> 27, 466. 91
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	5, 467. 35
	<hr/> 21, 999. 56
July 1, 1907, balance unexpended.....	21, 999. 56
July 1, 1907, outstanding liabilities.....	175. 00
	<hr/> 21, 824. 56
July 1, 1907, balance available.....	21, 824. 56
July 1, 1907, amount covered by uncompleted contracts.....	7, 550. 00

(See Appendix O O 6.)

7. *Black River at Port Huron, Mich.*—In 1888, when the original survey was made, the lower reach of the Black River, from its mouth to the Grand Trunk Railroad bridge,  $1\frac{1}{2}$  miles in length, varied in width from 120 to 150 feet and had a depth of from 10 to 14 feet, except at a few points, where it was obstructed by bars having only  $8\frac{1}{2}$  feet of water over them. The improvement of this stream was inaugurated by the river and harbor act of September 19, 1890, under a project which contemplated dredging to a navigable depth of 16 feet from the mouth to the Grand Trunk Railroad bridge, with widths varying from 75 feet to 160 feet, according to locality, at an estimated cost of \$75,000. Operations were begun in 1891 and continued until the summer of 1893, the act of July 13, 1892, directing that the improvement be extended 1,800 feet farther upstream to Washington avenue. The total length of dredged channel was 9,700 feet and the total expenditure to June 30, 1894, was \$34,698.65, completing the project. Additional work required is for maintenance.

Work of dredging the channel was done between May and September, 1897, again in July and August, 1900, and in September, 1903, a cut 25 feet in width was dredged through a shoal spot in the river above the Grand Trunk Railroad bridge.

Experience and observation show that the narrow dredged channels above the Grand Trunk Railroad bridge have no degree of permanence, although the canal to be cut by the city of Port Huron from Lake Huron to Black River, in the upper part of the town, for the purpose of flushing the stream should, if it has any effect at all, retard the deterioration somewhat.

The river has shoaled since the last dredging was done, and the work of removing the shoals existing in the river will be begun soon after the close of the fiscal year.

The amount expended on the work of existing project to June 30, 1907, is \$46,984.40, of which \$12,286.40 has been applied to maintenance of improvement.

As a result of the work done at this river a channel has been secured 16 feet in depth, with widths varying from 75 feet to 160 feet, according to locality, and extending from the mouth to the Washington Avenue Bridge, a total length of 9,700 feet. A 16-foot depth is available from the bar at the mouth to the Grand Trunk Railroad bridge. Between the latter point and Washington avenue shoaling is constant, and to maintain a depth of 16 feet requires annual dredging, which in recent years has been done by the Michigan Fiber Company. Such dredging renders available the 16-foot channel throughout the extent of the improvement. The period of such availability is rendered short by the shoaling above referred to.

There was received during the year 1906, 135,695 tons of freight, valued, approximately, at \$400,000. This consisted mainly of brick, coal, gravel, lumber, and pulp wood.

The effect of the improvement has been to reduce freight rates upon approximately the number of tons received. It is doubtful whether this improvement has any indirect effect upon freight rates.

More extended information will be found in the following Reports of the Chief of Engineers: 1893, pages 2938-2939; 1894, pages 2251-2252; 1898, 2586-2587.

Report of examination and survey is given in the Report of the Chief of Engineers for 1889, page 2292; reports of minor surveys, page 2993 of report for 1899, and page 3988 of report for 1900.

*Receipts and shipments by vessel.*

Calendar year.	Received.	Shipped.	Calendar year.	Received.	Shipped.
	<i>Tons.</i>	<i>Tons.</i>		<i>Tons.</i>	<i>Tons.</i>
1893.....	175,081	7,487	1900.....	105,931	181
1894.....	116,535	4,413	1901.....	120,015	100
1895.....	104,850	6,825	1902.....	123,677	2,600
1896.....	186,987	2,569	1903.....	163,265	.....
1897.....	96,925	1,455	1904.....	197,044	.....
1898.....	151,606	16,595	1905.....	169,200	.....
1899.....	130,675	37,368	1906.....	135,695	.....

July 1, 1906, balance unexpended..... \$127. 10  
 Amount appropriated by river and harbor act approved March 2, 1907..... 6,000. 00

June 30, 1907, amount expended during fiscal year, for maintenance of improvement..... 6, 127. 10  
 ..... 111. 50

July 1, 1907, balance unexpended..... 6, 015. 60

(See Appendix O O 7.)

8. *Pine River (St. Clair County), Michigan.*—Before improvement this stream had, in spite of its extreme crookedness, a quite uniform depth of from 8 to 15 feet for a distance of 5 miles from the mouth, with the exception of a few sand bars of insignificant extent.

The original project of July 19, 1875, provided for the expenditure of the \$5,000 appropriated in 1875. The work was done in 1875-76,



and resulted in securing a clear channel of 12 feet in depth from the mouth to a point 4,000 feet upstream.

The present project, adopted by act of June 3, 1896, provides for a channel 100 feet wide and 14 feet deep for a distance of 2,500 feet from the mouth, thence 75 feet wide and 12 feet deep to Belknap's brickyard, a total distance of 5,800 feet. The estimated cost was \$10,560. This project was completed under two contracts, one in 1896 and the other in 1899, at a total cost of \$8,646.89, including all contingencies to June 30, 1900.

No work was in progress during the past year.

The amount expended on this project to June 30, 1907, is \$9,677.86, of which amount \$1,030.97 has been applied to maintenance.

The available balance will be applied to such maintenance as may be necessary, and as the present channel is more than adequate for existing commerce no additional appropriation is needed.

The available depths in the dredged channel are 14 feet to the shipyard and 13 feet to Belknap's.

It has been impossible to obtain from local sources information as to the effect of the improvement on freight rates, but it is believed to have resulted in a reduction of 30 to 50 cents per ton on freight actually transported. Railroad rates have not been affected.

During the year 1906 13,495 tons of freight were received and shipped, valued approximately at \$31,489. It consisted almost entirely of brick and coal.

More extended information is given in the following Reports of the Chief of Engineers: 1897, pages 3024-3025; 1900, pages 3989-3990.

Reports of examinations and surveys are given in the Annual Reports of the Chief of Engineers as follows: 1873, page 306; 1875, page 280; 1885, page 2183; 1889, page 2282; 1893, page 2954; and 1895, page 2745.

*Receipts and shipments by vessel.*

Calendar year.	Received.	Shipped.	Calendar year.	Received.	Shipped.
	<i>Tons.</i>	<i>Tons.</i>		<i>Tons.</i>	<i>Tons.</i>
1898.....	100,608	1,150	1903.....	6,598	4,929
1899.....	734,725	7,060	1904.....	6,064	4,297
1900.....	370	5,173	1905.....	8,220	2,712
1901.....	237	2,145	1906.....	7,495	6,000
1902.....	767	4,842			

July 1, 1906, balance unexpended..... \$950. 21  
 June 30, 1907, amount expended during fiscal year, for maintenance of improvement..... 68. 07

July 1, 1907, balance unexpended..... 882. 14

(See Appendix O O 8.)

9. *Belle River, Michigan.*—This is a small stream, 125 to 150 feet wide, having an available depth of 6 feet before improvement. The original project, adopted in 1880, contemplated the formation of an ice harbor of refuge by dredging a channel 50 feet wide, 13 feet deep to the first bridge, and 12 feet deep from there to the second bridge, at an estimated cost of \$14,465. This work was completed between 1881 and 1885, at a cost of \$14,000.

The present project, adopted by act of June 3, 1896, provides for a channel 75 feet wide, 15 feet deep to the Bridge Street Bridge, and 14 feet thence to the Broadway Bridge, a total distance of 5,400 feet. The estimated cost was \$21,340. This work was accomplished from 1896 to 1899, at a cost of \$10,300.88.

No work was in progress during the past fiscal year.

The whole amount expended on the existing project to June 30, 1907, is \$11,158.16, of which \$857.28 has been applied to maintenance of improvement.

The available balance will be applied to such maintenance as may be necessary during the ensuing year.

Since completion in 1899 the dredged channel has deteriorated, and the available depths at present are believed to be 14 and 13 feet, respectively, in the two sections of the channel. The river is navigable by boats drawing not over 5 feet to the north boundary of Marine City.

During 1906 14,232 tons of freight were received and shipped, valued approximately at \$59,717. This consisted mainly of coal, gravel, and lumber.

The improvement is known to have had a beneficial effect upon freight rates for coal and lumber products. In the case of coal the saving is stated to be by one authority not less than 15 cents per ton. The total amount of saving in any one year as a result of the improvement can not be ascertained from local sources.

More extended information is given in the Reports of the Chief of Engineers for the following years: 1885, pages 2157-2159; 1897, pages 3025-3026.

Reports of examinations and surveys are given in the Annual Reports of the Chief of Engineers as follows: 1880, page 2059; 1893, page 2956; 1895, page 2746; and 1899, page 2996.

*Receipts and shipments by vessel.*

Calendar year.	Received.	Shipped.	Calendar year.	Received.	Shipped.
	<i>Tons.</i>	<i>Tons.</i>		<i>Tons.</i>	<i>Tons.</i>
1897.....	11,396		1902.....	12,499	1,736
1898.....	10,044	3,550	1903.....	15,604	1,408
1899.....	5,578	878	1904.....	5,777	846
1900.....	23,371	4,548	1905.....	4,003	983
1901.....	15,616	2,928	1906.....	12,954	1,278

July 1, 1906, balance unexpended.....	\$3,909.54
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	67.70

July 1, 1907, balance unexpended.....	3,841.84
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(See Appendix O O 9.)

10. *Clinton River, Michigan.*—This stream empties into Anchor Bay, in the northwesterly part of Lake St. Clair, and before improvement had a channel depth of about 10 feet, except at several shoals, over which but 5 or 6 feet could be carried, and a broad flat at the mouth with a general depth of 3 to 4 feet.

The act of August 30, 1852, appropriated \$5,000 for its improvement, and this money was expended during the years 1854-55.

On July 23, 1870, a project was submitted for the expenditure of the \$5,000 appropriated July 11, 1870. This sum was applied to dredging a channel 60 feet wide, 9 feet deep, and 2,700 feet long outward from the mouth. This improvement gradually deteriorated and by 1880 was obliterated, as shown by a survey then made, pursuant to the act of March 3, 1879.

In 1880 a project for the general improvement of the river was proposed, to cover the entire river from the mouth to Mount Clemens, 8 miles upstream. This project called for an 8-foot channel, a pile dike extending across the flat at the mouth to the 10-foot curve in the bay, for revetments as needed above, and for closing the main channel and making a straight cut through Shoemakers bend. The estimated cost was \$25,000, revised and amended in 1888 and 1889 to \$34,564. The project was completed in 1893 with the expenditure of \$34,546.26.

The work which has been in progress during the past fiscal year has consisted in removing the shoals which had formed in the river in order to restore a navigable depth of 8 feet, and was done under a contract with the Toledo Dredge and Dock Company, of Toledo, Ohio. The work is still in progress at the close of the fiscal year.

Up to August 5, 1886, all expenditures were made upon previous projects and amounted to \$25,500. Since that date the expenditures have been under the existing project. The total amount expended on the work of present project to June 30, 1907, is \$47,811.69, of which \$13,265.43 has been applied to maintenance.

The available balance will be applied to such maintenance as may be necessary and to repairing pile dike at the mouth of the river.

As a result of the work done on this river a channel 8 feet in depth has been secured from the mouth to the city of Mount Clemens, a pile dike has been built along the north side of the outer channel, and revetments have been built where needed in the river above. The present available depth throughout does not exceed 7 feet. The river is navigable for small boats a considerable distance above Mount Clemens.

There were received and shipped during the year 1906, 25,900 tons of freight, consisting mainly of coal, logs, lumber, and sand. This is valued, approximately, at \$77,000.

More extended information is given in the following Reports of the Chief of Engineers: 1893, pages 2942-2944, and 1894, pages 2254-2255.

Reports of examinations and surveys are given in the Reports of the Chief of Engineers as follows: 1872, page 214; 1876, Part II, page 549; 1880, page 2062; 1885, page 332; 1895, page 2838; 1899, page 3001; and 1900, page 3996.

*Receipts and shipments by vessel.*

Calendar year.	Received.	Shipped.	Calendar year.	Received.	Shipped.
	<i>Tons.</i>	<i>Tons.</i>		<i>Tons.</i>	<i>Tons.</i>
1896.....	30,749	410	1902.....	33,868	.....
1897.....	29,077	.....	1903.....	28,411	.....
1898.....	29,085	.....	1904.....	22,878	257
1899.....	35,525	.....	1905.....	41,759	540
1900.....	32,410	282	1906.....	25,616	284
1901.....	36,925	.....			

July 1, 1906, balance unexpended-----	\$4, 993. 31
Amount appropriated by river and harbor act approved March 2, 1907-----	2, 500. 00
	<hr/> 7, 493. 31
June 30, 1907, amount expended during fiscal year, for maintenance of improvement-----	241. 00
	<hr/> 7, 252. 31
July 1, 1907, balance unexpended-----	7, 252. 31
July 1, 1907, outstanding liabilities-----	2, 500. 00
	<hr/> 4, 752. 31
July 1, 1907, balance available-----	4, 752. 31
July 1, 1907, amount covered by uncompleted contracts-----	3, 000. 00
(See Appendix O O 10.)	

11. *Removing sunken vessels or craft obstructing or endangering navigation.*—A lighter sunk by ice at the mouth of Clinton River, Michigan, during the spring freshet of 1907 was completely removed during April under oral agreement at a total cost of \$105.13.

#### IMPROVEMENT OF WATERS CONNECTING THE GREAT LAKES.

This district was in the charge of Col. Chas. E. L. B. Davis, Corps of Engineers. Division engineer, Col. G. J. Lydecker, Corps of Engineers.

1. *Ship channel connecting waters of the Great Lakes between Chicago, Duluth, and Buffalo.*—Before the Government commenced the improvement of this water route navigation through the natural channels of the rivers by boats drawing about 8 feet of water was difficult and dangerous. Twelve feet draft was available through St. Marys River after dredging the middle channel through Lake George in 1858. The freight was largely carried by sailing vessels, and these and the few steamboats were limited in size to less than the dimensions of the State locks at the Sault, which were 350 feet long and 70 feet wide, with about 12 feet depth of water on the sills. Improvements were resumed by the Government in 1870, and the total commerce passing the canal that year was less than 540,000 tons. The completion of the Weitzel lock in 1881 and the simultaneous deepening of the Lake George channel permitted an increased draft to 16 feet at mean stage of water.

Prior to 1892 the improvement of this waterway was limited to individual places and local work, explained elsewhere under the heads of St. Marys River, Hay Lake, St. Clair Flats Canal, and Detroit River.

The present project was adopted by the river and harbor act of July 13, 1892, the object being to provide a navigable depth of 20 feet by excavating channels to a minimum width of 300 feet through the shoal places in the specified waters, at an estimated cost of \$3,340,000, the scope of improvement being limited to shoals not specially provided for by the then existing appropriations.

Under approval of the War Department, dated October 20, 1892, operations were commenced in the spring of 1893, and by 1897 channels of the prescribed depth of 20 feet, with widths of 300 feet or more, had been excavated through all the shoal areas originally specified in the project. Since 1898 the work has consisted in increasing the width and depth of channels at angles, exposed places, and other critical points and in removing many isolated shoals of comparatively small area that have been found to interfere with the safe navigation of the channel by the larger boats now in commission.

The project contemplated a depth of 20 feet below the mean water surfaces as determined by gauge readings up to the time of the project, viz, 601.5 for Lake Superior, 584.2 for St. Marys River at foot of Sault locks, 581.1 for Lake Huron, 575.5 for Lake St. Clair, and 572.6 for Lake Erie, referenced in feet above mean tide, New York. The daily variations in the water surface, usually very small in calm weather, may reach 2 feet in variable weather, or even 6 to 8 feet in severe storms on Lakes Superior and Erie. The changes in the monthly mean elevations of water surface may amount to from  $\frac{1}{2}$  foot to 2 feet in a single year, or as much as 4 feet in forty years, such changes being due to variations in annual precipitation, evaporation, and other causes. Since 1892 the prevailing water levels of Lakes Huron, St. Clair, and Erie have been almost continuously below the above-named elevations, and in consequence the actual draft available has been 17 to 19 feet. References for extended information are given in Annual Report of Chief of Engineers for 1904, page 582.

The total expenditure on the improvement to June 30, 1907, was \$3,328,602.80.

The present commerce is about ninety-six times that of 1870, thirty-nine times that of 1880, six times that of 1890, and more than double that of 1900. Operations during the fiscal year ending June 30, 1907, were as follows:

In St. Marys River the channel through Round Island shoal 1 was widened about 200 feet and through shoal 2 about 175 feet, and depth was made to 23 feet below 601.5. The work on shoal 1 is completed, and the improved channel is now 1,000 feet wide; about one month's work of diver with derrick boat, under contract now in force, removing ridges left by dredges, will complete the work on shoal 2 and provide a channel 975 feet wide, with a clear depth of 23 feet below 601.5.

The channel through Vidal shoals was deepened to 22 feet below 601.5 for a portion of the proposed width; from eighty to one hundred days' work of diver with derrick boat will be required to complete this improvement, which will provide a channel approach to the canal above the locks with a least width of 1,000 feet and a depth of 22 feet for a distance of  $4\frac{1}{2}$  miles.

The unexpended balance of previous appropriations will suffice for all work required to complete the improvements contemplated by the present approved project, providing \$11,397.20 for completion of the widening of the channel through Round Island shoal 2 and for deepening Vidal shoals from 21 to 22 feet and contingencies.

*St. Clair River.*—Regulations governing the use of channels at Stag Island were promulgated by the Secretary of War under date of January 8, 1907, and concurred in by the Canadian government, and watchmen were stationed at this point to report all violations.

The amount of freight carried through the St. Marys River section of the channel during the navigation season of 1906 was 51,751,080 tons, valued at \$537,463,454, exclusive of local traffic of about 1,500,000 tons. Statistics of traffic through the Detroit River indicate that 63,808,571 tons of freight, valued at \$662,971,053, passed during the season.

It is believed that to attribute to the improvement in channels the difference in freight rates of 1900 (1.18 mills per mile-ton) and 1906 (0.84 mills per mile-ton) would not exaggerate the effect of such

improvements, especially in view of the great increase in size and tonnage of lake vessels, due to the greater permissible draft, the carrying capacity of freight steamers having increased from about 8,000 tons in 1900 to 13,000 tons in 1907.

July 1, 1906, balance unexpended.....	\$80,496.40
June 30, 1907, amount expended during fiscal year, for works of improvement .....	69,099.20
July 1, 1907, balance unexpended.....	11,397.20
July 1, 1907, outstanding liabilities.....	4,662.91
July 1, 1907, balance available.....	6,734.29
July 1, 1907, amount covered by uncompleted contracts.....	2,380.91

(See Appendix P P 1.)

2. *St. Marys River at the falls, Michigan.*—Commercial navigation of the falls, or rapids, of this river at Sault Ste. Marie was impracticable until 1855, when the State of Michigan constructed a canal which provided a navigable channel for vessels whose draft was 11.5 feet at mean stage of water, at a cost of about \$1,000,000, the proceeds of 750,000 acres of land granted by the United States Congress. This improvement was completed in 1855, the double-lift lock having tandem chambers 350 feet long and 70 feet wide, with gate openings of 70 feet arranged for 9 feet average lift at each lock, and the canal being about 5,700 feet long, with an available width of 64 feet and a top width of 100 feet. The commerce in 1870 was about 540,000 tons per year.

In 1870 the United States entered upon a project for increasing the canal to at least 100 feet width, replacing the stone slope walls with timber revetment piers, building a new lock, and providing for 16 feet draft. The new lock (now known as the Weitzel lock) was opened to traffic in 1881, its single chamber being 515 feet long and 80 feet wide, narrowed at gate openings to 60 feet and arranged for 18 feet average lift. The cost of the work from 1856 to 1885, inclusive, was \$2,875,692, including \$10,000 diverted from the 1864 Great Lakes appropriation. A rapidly increasing commerce developed as a result of these improvements.

The project presented in reports dated October 18 and December 22, 1886, provided for building, on the site of the old State locks, a new lock with a single lift of 16 to 21 feet, the chamber being 800 feet long by 100 feet wide, with 21 feet of water at mean stage on the miter sills; also for deepening the canal and its approaches, all at an estimated cost of \$4,738,865. By authority of river and harbor act of August 5, 1886, work under this project was begun under War Department approval dated October 28, 1886, and the essential features of the project were so far completed in 1896 as to permit the new lock to be opened to navigation August 3 of that year. This lock has since been known as the Poe lock. Later work has consisted in completing the deepening of the canal and its approaches, rebuilding and extending canal piers, grading and improving canal grounds, etc.

The river and harbor act of June 13, 1902, authorized the following diversions from existing funds, namely, \$20,000 for special improvement at Sailors Encampment, \$20,000 for salaries and expenses of the International Waterways Commission, and \$85,000 estimated as the amount required to complete certain improvements at St. Clair Flats Canal, for which existing funds were insufficient. The act also pro-

vided for extending the work at the falls so as to include widening and further improvement of the canal above the locks in accordance with the project submitted in House Document No. 128, Fifty-sixth Congress, second session, but made no additional appropriation therefor.

The river and harbor act of March 3, 1905, authorized the expenditure under continuing contract of \$1,020,000 for widening canal as proposed in project submitted in House Document No. 215, Fifty-eighth Congress, third session. Of this \$1,020,000 there remains to be appropriated \$250,000, and this amount can be profitably expended during the fiscal year ending June 30, 1909, to be applied to rock and earth excavation, concrete revetment walls, timber piers, filling, movable dams, including head gates, and to superintendence and contingencies, all in accordance with project above mentioned.

The river and harbor act of March 2, 1907, adopted a project for the construction of a new lock, with a separate canal, in accordance with "plan 3" set forth in House Document No. 333, Fifty-ninth Congress, second session, at an estimated cost of \$6,200,000, of which \$1,200,000 has been appropriated and the balance authorized to be expended under continuing contract.

Commerce is now about ninety-six times that of 1870, thirty-nine times that of 1880, six times that of 1890, and more than twice that of 1900. (For details see p. 690.)

The water surface, usually changing slowly, may have an extreme range of 6 feet in a few hours, and the monthly mean elevation of water surface may change as much as 2 feet in one year or 4 feet during forty years.

During the fiscal year bids were received for widening the canal above the locks to provide a new channel 108 feet wide, but as the title to the lands deeded to the United States for this purpose was not considered adequate, no contract was entered into for the work. As the river and harbor act of March 2, 1907, provided for the acquisition and immediate occupancy of the land needed for this improvement, new specifications were prepared, and a portion of the land needed has been acquired.

Plans for a movable dam, to serve both the present and the widened canal, have been prepared, and a portion of the substructure has been built, \$17,975.93 having been expended on this item.

The purchase of lands included three lots, containing a total of about 0.43 acre, located north of Water street, at a cost of \$36,200, and a tract on north side of canal, containing 6.52 acres, at a cost of \$1. Also that part of River street located north of Water street, deeded by the city of Sault Ste. Marie to the United States for the nominal consideration of \$1.

The work on the project for a new canal and lock has been confined to surveys and studies for lock construction.

The works of the Michigan Lake Superior Power Company and the Chandler-Dunbar Water Power Company were inspected, and operations under their permits were supervised, as set forth in special reports.

The total expenditures to June 30, 1907, under present project are \$4,597,642.43, of which amount \$20,000 was applied to Sailors Encampment, \$1,704.22 to expenses of International Waterways Commission, and \$86,491.28 to the St. Clair Flats Canal, leaving an unexpended balance of \$2,117,926.79. The balance of the \$20,000

diversion (\$18,295.78) for International Waterways Commission was transferred to the Commission.

The commerce passing the falls during the navigation season of 1906, a period of eight months and nine days, amounted to 51,751,080 tons of freight, valued at \$537,463,454. The number of passengers reported during the same period was 63,033.

More detailed information may be found in Annual Report of the Chief of Engineers for 1886, pages 1792 to 1808.

## CANAL WIDENING, ETC.

July 1, 1906, balance unexpended.....	\$831, 654. 57
Amount appropriated by sundry civil act approved March 4, 1907.....	250, 000. 00
	<hr/>
June 30, 1907, amount expended during fiscal year, for works of improvement.....	1, 081, 654. 57
	<hr/>
	a 163, 727. 78
July 1, 1907, balance unexpended.....	917, 926. 79
July 1, 1907, outstanding liabilities.....	2, 645. 88
	<hr/>
July 1, 1907, balance available.....	915, 280. 91
Amount (estimated) required for completion of existing project.....	250, 000. 00
	<hr/>
{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907.....	250, 000. 00
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

## NEW LOCK AND CANAL.

Amount appropriated by river and harbor act approved March 2, 1907.....	\$1, 200, 000. 00
July 1, 1907, balance unexpended.....	1, 200, 000. 00
Amount (estimated) required for completion of existing project.....	5, 000, 000. 00

## CONSOLIDATED.

July 1, 1906, balance unexpended.....	\$831, 654. 57
Amount appropriated by river and harbor act approved March 2, 1907.....	1, 200, 000. 00
Amount appropriated by sundry civil act approved March 4, 1907.....	250, 000. 00
	<hr/>
	2, 281, 654. 57
June 30, 1907, amount expended during fiscal year, for works of improvement.....	a 163, 727. 78
	<hr/>
July 1, 1907, balance unexpended.....	2, 117, 926. 79
July 1, 1907, outstanding liabilities.....	2, 645. 88
	<hr/>
July 1, 1907, balance available.....	2, 115, 280. 91
	<hr/>
Amount (estimated) required for completion of existing project:	
Canal widening, etc.....	\$250, 000. 00
New lock and canal.....	5, 000, 000. 00
	<hr/>
	5, 250, 000. 00

{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement (widening canal), in addition to the balance unexpended July 1, 1907.....	250, 000. 00
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

(See Appendix P P 2.)

a Includes \$86,491.28 expended for improving St. Clair Flats Canal, Michigan, and \$4.17 paid by Treasury Department, account of Duluth, South Shore and Atlantic Railway Company.



3. *Operating and care of St. Marys Falls Canal, Michigan.*—This service is provided for by the permanent indefinite appropriation for operating and care of canals and other works of navigation under the provisions of section 4 of the river and harbor act of July 5, 1884.

The former conditions and results of improvement are the same as above stated for St. Marys River at the falls.

During the fiscal year ending June 30, 1907, the United States canal was open to navigation two hundred and thirty-nine days, the closed season being from December 18, 1906, to April 22, 1907, inclusive. A total of 15,653 vessels, aggregating 33,716,538 registered tons, and carrying 45,013,198 tons of freight and 29,248 passengers, passed through the locks in 9,925 lockages. The Canadian canal at Sault Ste. Marie, Ontario, open two hundred and forty-five days, made 4,183 lockages and passed 5,788 vessels, with an aggregate registered tonnage of 8,563,889, and carrying 9,648,421 tons of freight and 31,618 passengers. The combined traffic through the two canals amounted to 54,661,619 tons of freight and 60,866 passengers.

The principal items of freight during the past fiscal year through both canals were: Iron ore, 36,830,506 tons; coal, 10,177,945 tons; flour, 6,626,667 barrels; wheat, 92,933,768 bushels; other grain, 50,464,395 bushels; lumber, 845,456 M feet B. M., and general merchandise, 1,059,547 tons.

Other statistics in relation to this traffic and commerce for the calendar season of 1906 are summarized in the following statements:

*Summary of St. Marys River commerce, via American and Canadian canals, during the calendar season of 1906, viz, from April 13 to December 22, 1906, a period of two hundred and fifty-four days.*

Total freight carried, tons	51,751,080
Total net registered tons	41,098,324
Total mile tons	43,596,953,680
Total valuation placed on freight carried	\$537,463,454
Total amount paid for freight transportation	\$36,666,889
Total number of registered vessels using canals	879
Total number of passages by unregistered crafts carrying freight	810
Total valuation placed on registered vessels	\$94,532,500
Total number of passengers transported	63,033
Average distance freight was carried, miles	842.4
Average cost per ton for freight transportation	\$0.71
Average cost per mile per ton, mills	.84
Average value per ton of freight carried	\$10.39
Time American canal was operated, days	249
Time Canadian canal was operated, days	253
Freight carried by—	
Registered vessels, tons	51,652,262
Unregistered vessels, tons	98,818
American vessels, per cent	95
Canadian vessels, per cent	5
Passengers carried by—	
American vessels, per cent	43
Canadian vessels, per cent	57
Average number of vessels passing per day—	
Through Poe lock	40
Weitzel lock	28
Canadian lock	22
Poe, Weitzel, and Canadian locks	87

The total expenditure on this account from 1881, when the Weitzel lock was first put in service, to June 30, 1907 (excluding \$9,151.11 outstanding liabilities), amounts to \$1,491,301.99, of which \$7,364.18

related to operations during the past fiscal year. The growth of traffic during the same period is shown by the tabular statement which follows:

*Freight traffic by calendar years.*

	Tons.		Tons.
1881 .....	1,567,741	1894 .....	13,195,860
1882 .....	2,029,521	1895 .....	15,062,580
1883 .....	2,267,105	1896 .....	16,239,061
1884 .....	2,874,557	1897 .....	18,982,755
1885 .....	3,256,628	1898 .....	21,234,664
1886 .....	4,527,759	1899 .....	25,255,810
1887 .....	5,494,649	1900 .....	25,643,073
1888 .....	6,411,423	1901 .....	28,403,065
1889 .....	7,516,022	1902 .....	35,961,146
1890 .....	9,041,213	1903 .....	34,674,437
1891 .....	8,888,759	1904 .....	31,546,106
1892 .....	11,214,333	1905 .....	44,270,680
1893 .....	10,796,572	1906 .....	51,751,080

For effect of channel improvement on freight rates, see remarks under this head in report of ship channel connecting waters of the Great Lakes between Chicago, Duluth, and Buffalo.

(See Appendix P P 3.)

4. *Hay Lake and Neebish channels, St. Marys River, Michigan.*—The original condition of this waterway included rapids and shoals characteristic of St. Marys River, and though passible for small craft with 3 to 5 feet draft, the channel was not navigable for commercial purposes before improvement. The project for that part of the river below the canal provides for a channel 1,500 feet wide from the canal piers to upper entrance to Hay Lake.

The original project of improvement of 1882 contemplated the excavation of channels 17 feet deep and 300 feet wide through all obstructed portions of the Hay Lake route by way of the Middle Neebish, but this project was modified in 1886 to provide a depth of 20 feet and to widen at angles and other critical places, at a total estimated cost of \$2,659,115, and the modified project was adopted by river and harbor act of August 5, 1886. The work of improvement was commenced in 1883, under War Department approval of October 27, 1882, and by 1894 work had so far progressed that the route was opened to commerce June 7 of that year, though full width and depth of channel had not been obtained, and since that time several shoals in the deep-water section of the lake have been removed and the dredged channels have been widened at critical places.

The river and harbor act of June 13, 1902, appropriated \$500,000 and authorized work up to \$4,000,000 more (all of which has been appropriated) for improving Middle and West Neebish channels to provide for the commencement and prosecution of the project outlined in the preliminary report of June 4, 1900 (Annual Report of the Chief of Engineers for 1901, p. 3200), and the river and harbor act of March 3, 1905, appropriated \$500,000 and authorized work up to \$750,000 more for improving Hay Lake and Neebish channels for continuing this improvement, all of the last-named amount now remaining to be appropriated.

The part of the project outlined in the above-named reports relative to the river below the canal which has been covered by these two acts is to provide a channel 1,500 feet wide from the Sault locks to the upper entrance to Hay Lake; to widen and deepen the upper

entrance channel into Hay Lake so as to give a least width of 600 feet, with clear depth of 21 feet at low water; to excavate a new channel having least width of 300 feet and low-water depth of 21 feet between Hay Lake and Mud Lake by way of the West Neebish; and to deepen the Middle Neebish channel to give depth of 21 feet at low water, leaving its width unchanged. The effect of the execution of this project will be to provide a clear navigable depth of 21 feet from St. Marys Falls Canal to Lake Huron, the least width being 300 feet where two channels are provided, one for upbound and one for down-bound boats, and 600 feet at all other places.

Under the head of Middle and West Neebish channels the sundry civil act of March 3, 1903, appropriated \$800,000, that of March 3, 1905, \$1,200,000; that of June 30, 1906, \$1,000,000, and that of March 4, 1907, \$1,000,000, completing the appropriations authorized for this project. The total amount expended to June 30, 1907, on the Hay Lake and Neebish projects combined was \$6,472,623.45.

The lower approach channel to the canal, extending 2 miles to Little Rapids, upon completion of present contracts in August or September, 1907, will be 1,500 feet wide and 21 feet deep below 580.3.

The upper entrance channel to Hay Lake is now 600 to 1,700 feet wide, and, upon completion of a small area below Six-mile Point, will have a least depth of 21 feet at mean low water to the 21-foot contour in Hay Lake. The lower entrance channel through the Middle Neebish Rapids has a width of 300 feet for a distance of 5 miles and a depth of 20 feet at mean stage of water.

For the 8 miles through Little Mud Lake and past Sailors Encampment into Mud Lake the channel is 300 feet wide for  $2\frac{1}{2}$  miles, and upward of 600 feet for remainder of distance, and all was dredged to a depth of 21 feet at mean stage of water. This channel is provided with range lights and gas buoys as aids to night navigation, and as it is now 5 feet deeper and 11 miles shorter than the old channel by the way of Lake George, the latter route has been practically abandoned except for rafts. The artificially improved channel way in St. Marys River between Lakes Superior and Huron by the Middle Neebish route is  $22\frac{1}{2}$  miles long.

The commerce during the season of 1906 amounted to 51,751,080 freight tons.

The West Neebish route is closed to navigation, and that channel will not be opened till completion of the rock section early in 1908.

The water surface, usually changing slowly, may rise or fall 2 feet during a severe storm, and the monthly mean may change as much as 2 feet in one year or 4 feet during forty years.

More extended information, with sketches and maps, may be found in Annual Reports of the Chief of Engineers for 1886, pages 1792-1808 (special history), and 1895, pages 2866 and 3052.

During the fiscal year the deepening of the channel from Little Rapids to Six-mile Point was completed.

The channel across the flats of Hay Lake entrance to West Neebish was completed and 94 per cent for the Mud Lake flats and 82.3 per cent for the section at West Neebish, including the limestone rock.

The estimated amount to complete continuing contracts (including payment of outstanding liabilities) is \$710,000.

The funds on hand, amounting to \$849,116.36, will be applied to payment for rock excavation, revetment walls, dredging, cribs for

lights, superintendence and contingencies, all in accordance with the approved project.

Under the Hay Lake and Neebish project the widening of the entrance angle to the Middle Neebish was completed, providing a channel about 800 feet wide with a depth of 21 feet at low-water stage.

About 40 per cent of the deepening of the channel over Shoal 28 in Mud Lake was done.

The funds on hand amount to \$337,375.19, and \$500,000 additional will be needed for work during the fiscal year ending June 30, 1909, to be applied to payment for dredging, constructing and placing cribs for lights, superintendence and contingencies, all in accordance with approved project.

For statistics of commerce and effect of channel improvements on freight rates attention is invited to remarks on these subjects in reports for operating and care of St. Marys Falls Canal, Michigan, and for ship channel connecting waters of the Great Lakes between Chicago, Duluth, and Buffalo.

## MIDDLE AND WEST NEEBISH CHANNELS.

July 1, 1906, balance unexpended.....	\$1, 203, 408. 72
Amount appropriated by sundry civil act approved March 4, 1907.....	1, 000, 000. 00
	<hr/> 2, 203, 408. 72
June 30, 1907, amount expended during fiscal year, for works of improvement.....	<sup>a</sup> 1, 354, 292. 36
July 1, 1907, balance unexpended.....	849, 116. 36
July 1, 1907, outstanding liabilities.....	289, 628. 00
July 1, 1907, balance available.....	<hr/> 559, 488. 36
July 1, 1907, amount covered by uncompleted contracts.....	<hr/> 429, 515. 00

## HAY LAKE AND NEEBISH CHANNELS.

July 1, 1906, balance unexpended.....	\$405, 050. 67
June 30, 1907, amount expended during fiscal year, for works of improvement.....	67, 675. 48
July 1, 1907, balance unexpended.....	337, 375. 19
July 1, 1907, outstanding liabilities.....	8, 666. 00
July 1, 1907, balance available.....	<hr/> 328, 709. 19
July 1, 1907, amount covered by uncompleted contracts.....	31, 054. 00
Amount (estimated) required for completion of existing project.....	750, 000. 00
<hr/>	
{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907.....	
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897.....	
	500, 000. 00

(See Appendix P P 4.)

5. *St. Clair Flats Canal, Michigan.*—Before the Government commenced work, in 1855, at this locality, boats were obliged to follow

<sup>a</sup> Includes \$18.03 paid by Treasury Department, account of Michigan Central Railroad Company; \$12.08 paid by Treasury Department, account of Duluth, South Shore and Atlantic Railway Company, and \$2.85 paid by Treasury Department, account of Superintendent of Documents.

the natural channels of the St. Clair River, where the draft was less than 11 feet, in order to get from the river into Lake St. Clair.

Between 1855 and 1865 the Government spent \$45,000 in gaining 1 or 2 feet depth temporarily through these channels. The present improvement dates from 1866, and proposed a straight dredged cut across a flat where the depth was only about 6 feet, the object being to secure 13 feet depth over 300 feet width of channel, modified in 1872 to give 16 feet, and in 1886 to give 18 and 20 feet, all at a total cost of \$1,326,060, as adopted by the river and harbor acts of June 23, 1866, and September 19, 1890, and approved by the War Department under various dates from 1866 up to October 9, 1890. This work was practically completed to 18 feet depth by 1892, after which it was incorporated into the 20-21-foot ship channel.

The dredged material was deposited so as to form dikes on each side of the cut, the channel faces of which are sustained by sheet-pile revetments. In its present condition the width of waterway between revetments is 292 feet, depth of water 20 feet at mean stage, and length of each lateral dike 7,221 feet.

The water surface, usually changing slowly, may rise or fall 2 feet during a severe storm, and the monthly mean may change as much as 2 feet in one year, or 4 feet during forty years.

The river and harbor act of June 13, 1902, appropriated \$330,000 and authorized the diversion from the St. Marys River appropriation of as much more as might be needed to commence and complete a second channel of 20 feet depth and 300 feet width alongside the existing channel, so as to provide two separate channels.

The total amount appropriated for this improvement from its beginning in 1866 is \$1,094,810, all of which has been expended, in addition to \$86,491.28 diverted from the appropriation for "Improving St. Marys River at the falls," making the total expenditures \$1,181,301.28.

During the fiscal year work for the construction of the new channel was completed. The lower pierhead and 74 linear feet of revetment were built and 783,564 cubic yards of material excavated. The new channel was dredged 300 feet wide for 17,460 linear feet below the upper light-house.

Since commencing the work of constructing the new channel the upper and lower pierheads and 7,220 linear feet of revetment have been built and 2,044,801 cubic yards of material excavated. This new channel was opened to commerce on September 3, 1906.

The commerce through the St. Clair Flats Canal during the season of 1906 was 60,589,441 tons of 2,000 pounds. Its estimated value is \$629,524,292.

For effect of channel improvements on freight rates see remarks under this head in report of ship channel connecting waters of the Great Lakes between Chicago, Duluth, and Buffalo.

July 1, 1906, balance unexpended.....	\$59,232.74
June 30, 1907, amount expended during fiscal year, for works of improvement .....	" 59,232.74

(See Appendix P P 5.)

6. *Operating and care of St. Clair Flats Canal, Michigan.*—This service is provided for by the permanent indefinite appropriation for

"In addition to this amount \$86,491.28 was expended from the appropriation for "Improving St. Marys River at the falls."

operating and care of canals and other works of navigation under the provisions of section 4 of the river and harbor act of July 5, 1884.

Operations for the past fiscal year were of the same routine character as those carried on since the canal was opened to traffic in 1871, viz, a custodian was present during the season of navigation to watch the passage of vessels, enforce regulations respecting traffic through the canal, and supervise all work provided for the care and repair of the canal dikes.

Repairs were made to the sheet piling on the east side of the east dike, tie-rods were placed where needed, and rock was placed in the lower end of the east dike and on the berms around the upper and lower ends of the west dike.

The expenditure to June 30, 1907, was \$159,906.95 (excluding \$668.51 estimated outstanding liabilities), of which \$384.31 was for the service of the preceding year.

(See Appendix P P 6.)

7. *Detroit River, Michigan.*—Before improvement the shoalest part of the channel through Detroit River was at the Limekiln Crossing, where the normal depth was from 12½ to 15 feet over a bottom of solid rock.

The water surface, usually changing slowly, may rise or fall from a few inches during many days of calm weather to about 4 feet during severe storms and to about 6 feet during short, severe hurricanes, and the monthly mean may change as much as 2 feet in one year or 4 feet in forty years.

The first project of 1874 provided for a winding channel of at least 20 feet depth, over 300 feet width; modified in 1883 so as to somewhat straighten such channel; in 1886 to give 400 feet width, and in 1888 to give 440 feet width. The general depth above and below the Limekiln was 20 feet or more, but the bed of the river was studded with large boulders and rocky shoals, which limited the safe navigable depth to scant 15 feet through a distance of about 12 miles.

A general project of improvement was thereupon adopted in 1892 providing for the removal of all obstructive shoals between the city of Detroit and Lake Erie, with a view to obtaining a through channel with a least width of 600 feet and a navigable depth of 20 feet, at a total estimated cost of \$1,554,500, as adopted by river and harbor acts of July 13, 1892, and March 3, 1899, and as approved by the War Department at various dates from 1892 up to July 3, 1899. All of this amount has been appropriated and expended.

The river and harbor act of June 13, 1902, adopted a new project to provide 21 feet minimum low-water depth over 600 feet minimum width of channel from Detroit through Detroit River to Lake Erie, at an estimated cost of \$3,750,000. (See Annual Report of the Chief of Engineers for 1905, pp. 2292-2296.) This project was later modified in accordance with approval of the War Department, dated November 12, 1904, to permit of slightly shifting the location of the proposed channel at Bar Point shoals, mouth of Detroit River, without increasing the cost.

This project has been prosecuted under continuing contracts, and the river and harbor act of March 2, 1907, authorized still further prosecution to the extent of \$150,000, yet to be appropriated.

The channel to Wyandotte, Mich., was improved in 1904.

The river and harbor act of March 2, 1907, also appropriated \$2,000,000 and authorized work under continuing contract up to \$4,670,950 more (yet to be appropriated), for the commencement and prosecution of a new project, plan B, to provide a second channel at the mouth of Detroit River, 22 feet deep from the present channel at Grosse Isle south channel range to a junction with the same channel at Detroit River light-house and a new outlet thence (east route) into Lake Erie with widths of 300 feet out to Bar Point and 800 feet thence to deep water in Lake Erie. The estimated cost of this project is \$6,670,950.

The total expenditure on the improvement up to June 30, 1907, was \$3,187,849.20. As a result of the work done to that date, a channel ranging from 500 to 1,200 feet in width was obtained, in which there was a least depth of 17 feet at the minimum low-water stage of 570.8 at Lake Erie and from 19 to 21 feet through most of the distance.

For the head of the river, at Grossepoint, a preliminary examination was favorably reported on December 26, 1888, followed by survey reports of February 8, 1890 (printed together as H. Ex. Doc. No. 200, 51st Cong., 1st sess.; also Annual Report of Chief of Engineers for 1890, pp. 2749-2752).

More extended information may be found as follows: Annual Reports of Chief of Engineers for 1891, pages 2794-2801 (special history); 1896, page 2758 (map), and 1904, pages 3140-3148; also House Document No. 160, Fifty-eighth Congress, second session (main channel to Wyandotte, Mich.), and House Document No. 266, Fifty-ninth Congress, second session (ship channel connecting waters of the Great Lakes).

The commerce for the calendar year 1906 was 63,808,571 freight tons, which was mainly through freight from Lake Erie to Lakes Superior and Michigan, or from those places to Detroit, being about 25 per cent greater than that for 1902.

Work under the 1902 project, which provides for a channel with a least width of 600 feet and a depth of 21 feet at a Lake Erie stage of 570.8 feet, was performed during the fiscal year under continuing contracts at Limekiln Crossing, Bois Blanc Island range, Amherstburg reach, Hackett range, and Bar Point shoals.

Work under the 1907 project for the improvement of a second channel at the mouth of Detroit River has been limited to the making of surveys and the preparation of specifications for the governing of contracts.

Extensive surveys were also made relating to present and future work.

For effect of channel improvements on freight rates see remarks under this head in report of ship channel connecting waters of the Great Lakes between Chicago, Duluth, and Buffalo.

Additional funds to the extent of \$1,650,000 will be required for the prosecution of the project for improvement of the lower Detroit River during the year ending June 30, 1909, of which amount \$150,000 will be applied principally to the widening and deepening of the channel at Limekiln Crossing and Hackett range, and \$1,500,000 will be applied to the improvement of the second channel at plan B.

## PLAN A, 21-FOOT CHANNEL.

July 1, 1906, balance unexpended.....	\$942, 245. 53
Amount appropriated by river and harbor act approved March 2, 1907 .....	150, 000. 00
	<hr/> 1, 092, 245. 53
June 30, 1907, amount expended during fiscal year, for works of improvement .....	<sup>a</sup> 425, 594. 73
July 1, 1907, balance unexpended.....	666, 650. 80
July 1, 1907, outstanding liabilities.....	201, 570. 00
July 1, 1907, balance available.....	465, 080. 80
July 1, 1907, amount covered by uncompleted contracts.....	400, 600. 00
Amount (estimated) required for completion of existing project.....	<hr/> 1, 450, 000. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907.....	
Submitted in compliance with requirements of sundry civil act of June 4, 1897.	
	150, 000. 00

## PLAN B, 22-FOOT CHANNEL.

Amount appropriated by river and harbor act approved March 2, 1907 .....	\$2, 000, 000. 00
July 1, 1907, balance unexpended.....	2, 000, 000. 00
Amount (estimated) required for completion of existing project.....	<hr/> 4, 670, 950. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907.....	
Submitted in compliance with requirements of sundry civil act of June 4, 1897.	
	1, 500, 000. 00

## CONSOLIDATED.

July 1, 1906, balance unexpended.....	\$942, 245. 53
Amount appropriated by river and harbor act approved March 2, 1907, plan "A" .....	150, 000. 00
Amount appropriated by river and harbor act approved March 2, 1907, plan "B" .....	2, 000, 000. 00
	<hr/> 3, 092, 245. 53
June 30, 1907, amount expended during fiscal year, for works of improvement .....	<sup>a</sup> 425, 594. 73
July 1, 1907, balance unexpended.....	2, 666, 650. 80
July 1, 1907, outstanding liabilities.....	201, 570. 00
July 1, 1907, balance available.....	<hr/> 2, 465, 080. 80
July 1, 1907, amount covered by uncompleted contracts.....	400, 600. 00
Amount (estimated) required for completion of exist- ing project.....	<div> <div>plan "A"</div> <div>plan "B"</div> </div> <div> <div>1, 450, 000. 00</div> <div>4, 670, 950. 00</div> </div>
{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907.....	
Submitted in compliance with requirements of sundry civil act of June 4, 1897.	
	<sup>b</sup> 1, 650, 000. 00

(See Appendix P P 7.)

<sup>a</sup> Includes \$0.59 paid by Treasury Department, account of Lake Shore and Michigan Southern Railway Company.<sup>b</sup> Of this amount \$150,000 is for 21-foot channel, plan A, and \$1,500,000 is for auxiliary channel 22 feet deep, in accordance with new project, plan B.



8. *Removing sunken vessels or craft obstructing or endangering navigation.*—The following obstructions were completely removed during the fiscal year:

Tug *Fannie Tuthill*, from channel in Lake St. Clair, total cost \$535.90.

Schooner *City of Toledo*, from Detroit River above Belle Isle bridge, total cost \$2,300.

Steamer *Nelson Mills*, from channel in St. Clair River, total cost \$1,000.

A spar projecting from the wreck of the barge *Checotah* was removed by the U. S. tug *Johnson*. This wreck is situated in Lake Huron about 19 miles south of Harbor Beach, Mich., but does not form an obstruction to navigation. The total cost was \$37.85.

The floating cabin deck of the wrecked steamer *New Orleans* was removed from the track of vessels in Lake Huron and towed to shallow water by the U. S. tug *Johnson*. The total cost was \$41.25.

The wreck of the steamer *Eliza H. Strong* in Lake Huron, off Lexington, Mich., was partially removed by the underwriters, and it is expected that they will complete the work. Cost of examination of wreck, \$57.97.

The work of removing the wrecked steamer *Linden* from St. Clair River was in progress.

An unknown wreck was reported as a dangerous obstruction near Thunder Bay Island light-house by the U. S. Lake Survey steamer *Search* during June, 1907, and an allotment was requested for its removal.

(See Appendix P P 8.)

SURVEY MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT APPROVED  
MARCH 3, 1899.

Report dated December 3, 1906, required by the river and harbor act approved March 3, 1899, on *survey of the connecting waters between Lakes Superior and Huron with plan and estimate of cost of a new lock at St. Marys Falls Canal, Michigan*, was submitted by the district officer and was transmitted to Congress and printed in House Document No. 333, Fifty-ninth Congress, second session. The plan presented contemplates the construction of an additional lock with channel of approach independent of the existing canal at an estimated cost of \$6,200,000.

EXAMINATION AND SURVEY MADE IN COMPLIANCE WITH RIVER AND HAR-  
BOR ACT APPROVED MARCH 3, 1905.

Reports dated April 10, 1905, and January 12, 1906, required by the river and harbor act approved March 3, 1905, on *preliminary examination and survey of ship channel connecting the waters of the Great Lakes between Chicago, Duluth, and Buffalo, with a view to obtaining depths of 22 and 25 feet, respectively, and sufficient width*, were submitted by the district officer and were reviewed by the Board of Engineers for Rivers and Harbors, pursuant to law. They were transmitted to Congress and printed in House Document No. 266, Fifty-ninth Congress, second session. A plan for improvement is presented which contemplates the excavation of an auxiliary channel in Detroit River 22 feet deep and designated as plan B, east route, at an estimated cost of \$6,670,950.

## IMPROVEMENT OF HARBORS ON LAKE ERIE IN THE STATE OF OHIO.

This district was in the charge of Lieut. Col. C. McD. Townsend, Corps of Engineers. Division engineer, Col. G. J. Lydecker, Corps of Engineers.

1. *Toledo Harbor, Ohio.*—The harbor of Toledo is in the Maumee River. The wharf frontage on the river extends over a distance of about 3 miles, the lower end of which is about 4 miles above the mouth of the river, at the head of Maumee Bay.

Originally, in the bay, the least depth was 8.5 feet with a prevailing depth of 12 feet, while in the river the minimum depths were 14 feet.

In 1866 a project was adopted to dredge the channels of deepest water in the bay to a depth of 12 feet. The project was amended from time to time until 1887, when the old indirect channel had a minimum depth of 15 feet.

In 1887 a project was adopted for a straight channel through Maumee Bay, with a depth of 17 feet and a bottom width of 200 feet. The estimated cost, including dikes or other channel protections, was \$1,875,000.

The project for a straight channel was amended in 1893 by increasing the width of outer section, about 3 miles long, to 300 feet. Since 1892 the improvement has been extended to include the Maumee River.

The total amount expended on original and modified projects prior to operations under existing project is \$1,617,695.45.

The present project was adopted by the river and harbor act of March 3, 1899, and is described in the Report of the Chief of Engineers, 1898, pages 2693 to 2705, inclusive. It provides for a channel in the bay and river 400 feet wide and 21 feet deep to Fassett Street Bridge, and 200 feet wide and 21 feet deep for the section above the bridge, with a turning basin 500 feet wide at the upper end. A dike was also to be constructed 1,000 feet in length between the range lights in the bay. The estimated cost of the work was \$1,005,000. A continuing contract was authorized for its execution, the limit of cost being fixed at \$950,000.

The work contemplated by this project has been completed with the exception of the channel and basin above the Fassett Street Bridge, which has a width of only 100 feet.

The total expenditure under the existing project to the close of the fiscal year ending June 30, 1907, was \$862,446.37.

The deepening of the bay to the Wheeling and Lake Erie Railroad bridge has been done under contract, and the deepening of the river above by the U. S. dredge *Maumee*. The dredging under this contract was completed October 9, 1905, a total of 5,854,456 cubic yards having been removed.

During the past year the U. S. dredge *Maumee* excavated 51,301 cubic yards above the Fassett Street Bridge and 2,718 cubic yards at the Lake Shore Railway bridge, making a total of 998,653 cubic yards excavated from the channel by this plant since the adoption of the present project. The dike between the range lights in the bay was finished September 2, 1906, completing all of the project under continuous contract with The Lydon & Drews Company.

Since the completion of this contract the U. S. dredge *Burton* has excavated 48,096 cubic yards from the Maumee River between Mag-nolia and Ash streets and 195,801 cubic yards from the inner division of the straight channel, at a total cost of \$27,239.19 for the main-tenance of the channel. On June 30, 1907, the maximum draft that could be carried over the shoalest portion of the channel was 20 feet.

The result of these expenditures has been to create and maintain a channel through Maumee Bay and river 400 feet wide and 20 feet deep to Fassett Street Bridge, a distance of 15 miles, and to a width of 100 feet and depth of 20 feet for 1 mile above this bridge. The Maumee River is also navigable for vessels of 6-foot draft to Perrys-burg, 15 miles above the mouth.

The usual variations in the level of the water surface during the sea-son of navigation range from 1 foot above to 2 feet below mean lake level. Extreme fluctuations, due to wind, of 7.9 feet above to 7.1 feet below mean lake level have, however, been observed at Toledo.

There has been a marked reduction in freight rates since the project was inaugurated, but this has been due not only to the work at this particular harbor, but to that at the other harbors along the lakes and the improvements in the channels connecting, as is shown by the report of the traffic passing through the Sault Ste. Marie, and it is impracticable to determine how much of this reduction is due to this particular improvement.

There are sufficient funds for completing the project and for its maintenance during the fiscal year ending June 30, 1909.

The commerce of Toledo for the calendar year 1906 amounted to 4,522,280 tons, an increase of 908,891 tons over that reported for the calendar year 1905.

July 1, 1906, balance unexpended.....	\$183, 377. 33
Receipts from sales.....	1, 683. 44
	<hr/> 185, 060. 77
June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$52, 089. 42
For maintenance of improvement.....	19, 344. 42
	<hr/> 71, 433. 84
July 1, 1907, balance unexpended.....	113, 626. 93
July 1, 1907, outstanding liabilities.....	11, 066. 12
	<hr/> 102, 560. 81
July 1, 1907, balance available.....	<hr/> 1, 388. 85

(See Appendix Q Q 1.)

2. *Port Clinton Harbor, Ohio.*—The harbor of Port Clinton is within the mouth of the Portage River. This river flows into Lake Erie at a point about 13 miles by land and 22 miles by water west of the city of Sandusky. In its natural condition the depth of water on the bar at the mouth of the river rarely exceeded 5 feet.

The original project for its improvement was adopted in 1871 and slightly modified in 1872 and 1873. It provided for the construction of two parallel jetties extending outward from the mouth of the river to a depth of 10 feet in the lake, at an estimated cost of \$90,000.

The work done consisted mainly of sheet piling of oak plank, secured and reenforced by oak piles, with heavy oak waling pieces. The pierhead of the east jetty was a solid construction of piles and

stone, and 720 linear feet of west jetty consisted of a substructure of piles with superstructure of timber cribwork, both filled with stone.

The jetties were extended to a depth of 10 feet in the lake in 1883, at which time the east jetty had been extended 2,180 linear feet and the west jetty 1,948 linear feet. These lengths were found ample for the requirements of this harbor, and in 1894, at which time a total expenditure of \$76,000 had been made, it was recommended that the remainder of the estimated cost of executing the project (\$21,000) be expended for necessary repairs.

The project since 1894 has therefore been one for maintenance, under which \$25,000 has been expended.

The result of these expenditures has been to produce a channel 11.3 feet in depth, extending for one-half mile above the mouth of the Portage River, which was the maximum draft that could be carried June 30, 1907. A channel of 6 feet depth extends to Oak Harbor, 12 miles above the mouth of the river.

The project has had little effect on freight rates, as the commerce of the port is small.

Plans and specifications have been prepared and a contract let for continuing the repair and reenforcement of the jetties under appropriation of \$3,000 for maintenance contained in the river and harbor act of March 2, 1907.

The commerce of Port Clinton for the calendar year 1906 amounted to 11,930 tons, a decrease of 1,452 tons from that reported for the calendar year 1905.

July 1, 1906, balance unexpended.....	\$1, 859. 97
Amount appropriated by river and harbor act approved March 2, 1907.....	3, 000. 00
	<hr/>
	4, 859. 97
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	1, 859. 97
	<hr/>
July 1, 1907, balance unexpended.....	3, 000. 00
July 1, 1907, outstanding liabilities .....	45. 94
	<hr/>
July 1, 1907, balance available.....	2, 954. 06

(See Appendix Q Q 2.)

3. *Sandusky Harbor, Ohio.*—The harbor of Sandusky is in the lower part of Sandusky Bay, along the city front, the part nearest to the lake being about 2 miles from the bar which divides the waters of the bay from those of the lake. In its natural condition the depth was only such as the bay afforded, which was about 10 feet along the city front and from 9 to 12 feet thence to the lake.

A long, flat sand bar divided the bay from the lake, this bar being cut through by a channel from 1,000 to 2,000 feet in width near its central portion. The southern part of the bar is called "Cedar Point" and the northern "Sand Point." Between these two points the currents between the bay and the lake had scoured out the channel to a depth of not less than 18 feet for a distance of a mile or more.

The first appropriation was made for a survey in 1826 and the first improvement was made in 1844, consisting in the construction of a dam to close a breach across Sand Point. With this exception, all the improvements made previous to 1896 consisted in deepening natural channels and in making a new straight channel from the city front to Cedar Point and in removing sand and bowlders from the

dock channel along the city front. Natural causes have washed away a greater part of Sand Point since 1826.

In 1896 and subsequently the project was added to so as to provide for the construction of parallel jetties of stone upon mattress foundations extending from Cedar Point and Sand Point outward, with a view to confining and directing the flow of water to and from the bay. Provision was also made for the construction of certain spurs and mattresses for the protection of the channel near Cedar Point and at the point of the bar near the light-house.

Under the original project thus modified there was expended \$476,749.09.

The present project, authorized by the river and harbor act of March 3, 1899, is described in the Annual Report of the Chief of Engineers for 1898, pages 2708 to 2716, inclusive. It provides for a jetty of stone upon brush mattresses extending from Cedar Point about 5,000 feet into the lake; for a west jetty 5,550 feet long on the opposite side of the channel, about 750 feet distant; for the protection of the crest of the bar and shore of Sand Point with a low dam of brush and stone, and for a deflecting dike for inner bar 1,500 feet long, and dredging to 17 feet. The estimated cost was \$425,796, of which \$317,796 was for permanent works. By the river and harbor act of June 13, 1902, the project was modified so as to provide for dredging a channel 21 feet deep at mean lake level with a width of 400 feet in the approaches to the harbor front and 300 feet in the harbor channel, at an estimated cost of \$781,000, as described in the Report of Chief of Engineers, 1901, pages 3270 to 3277, inclusive. The estimated cost of the entire project as revised in 1903 was \$1,135,000.

The act of March 3, 1905, modified the project by omitting therefrom the excavation of rock other than that already provided for by contract in the dock channel and fixed the limit of expenditures at \$815,000. Continuing contracts in excess of cash appropriations were authorized by the same act to the amount of \$480,000, of which \$130,000 remains to be appropriated. The act of March 2, 1907, restored this work of rock removal to the project and appropriated \$125,000 for maintenance and continuing the improvement. In the interim the city of Sandusky has removed considerable rock from the channel and remaining rock can be removed with the funds appropriated for the purpose.

The total expenditures under the present project for improving Sandusky Harbor to June 30, 1907, is \$433,678.05, of which amount \$24,675.46 was for maintenance during the past three years. Prior to that time the amount expended for works of improvement and for maintenance was so involved that it would be impracticable to separate them.

Under the authorization contract for dredging about 2,000,000 cubic yards of material in the straight channel and dock channel is being excavated, and under the appropriation of \$125,000 in the river and harbor act of March 2, 1907, plans and specifications have been prepared and proposals invited for continuing the rock excavation in the dock channels. The excavation of the channel through the outer bar, being in an exposed locality, is to be done by the Government hydraulic dredge.

During the past year the contractors have removed 629,644 cubic yards of rock from the inside channels,

and the U. S. dredge *Burton*, working on the outer bar from December 15 to 22, removed 4,014 cubic yards. A considerable portion of the rock excavation from the west dock channel was deposited in the extension of the east jetty, where it could be used for building up this jetty. The U. S. dredge *Maumee* worked at Sandusky during May and June, and built up 400 linear feet of this jetty to about the water surface with this material.

The result of these expenditures has been to create a channel 300 feet wide and 20 feet deep through the outer bar, 400 feet wide and 20 feet deep to the city front, and 200 feet wide and 18 feet deep along the city front to the Short Line docks, completing 83 $\frac{3}{4}$  per cent of the work now under contract.

There has been a marked reduction in freight rates since the project was inaugurated, but this has been due not only to the work at this particular harbor, but to that at the other harbors along the lakes and the improvements in the channels connecting, as is shown by the report of the traffic passing through the Sault Ste. Marie; and it is impracticable to determine how much of this reduction is due to this particular improvement.

There is a general depth of 10 feet in Sandusky Bay to the mouth of the Sandusky River, 14 miles above the city, and of 8 feet in the river to Fremont, Ohio, 18 miles above its mouth. The usual variation in the level of the water surface is the same as at Toledo, with extreme fluctuations of 5 feet above and below mean lake level.

The sum of \$115,000 can be profitably expended in the fiscal year ending June 30, 1909, for jetty construction.

The receipts and shipments at the harbor of Sandusky for the calendar year 1906 amounted to 1,366,663 tons, a decrease of 102,014 tons from that reported for the calendar year 1905.

July 1, 1906, balance unexpended.....	\$202, 623. 63
Amount appropriated by river and harbor act approved March 2, 1907.....	125, 000. 00
Amount appropriated by sundry civil act approved March 4, 1907.....	175, 000. 00

502, 623. 63

June 30, 1907, amount expended during fiscal year, for works of improvement.....	120, 858. 77
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July 1, 1907, balance unexpended.....	381, 764. 86
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July 1, 1907, outstanding liabilities.....	14, 881. 24
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July 1, 1907, balance available.....	366, 883. 62
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July 1, 1907, amount covered by uncompleted contracts.....	80, 528. 16
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Amount (estimated) required for completion of existing project.....	135, 000. 00
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{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907.....	115, 000. 00
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

(See Appendix Q Q 3.)

4. *Huron Harbor, Ohio.*—This harbor is situated at the mouth of Huron River. In its natural condition the entrance was practically closed by a sand bar.

The first project for its improvement was adopted in 1826 and provided for the construction of two parallel jetties 140 feet apart, extending outward from the river banks. These jetties were length-

ened from time to time and repaired as required, and the channel was finally deepened by dredging.

The total amount expended upon these projects for all purposes of construction and maintenance to June 30, 1905, was \$269,908.95.

The present project for the improvement of this harbor was authorized by the river and harbor act of March 3, 1905. It is based upon a survey, plan, and estimate called for by the river and harbor act of June 13, 1902, and is published in full in the Report of the Chief of Engineers for 1904, pages 3209 to 3218, inclusive.

This plan utilizes all that portion of the west jetty which is serviceable, rebuilds 580 linear feet, and extends the jetty 240 feet and terminates it at its outer extremity in a pierhead 50 feet square. A new east jetty is also constructed, consisting of a pierhead of the same dimensions as that on the west jetty and 300 feet easterly from it. From the pierhead a new jetty of rubble-mound type extends to a point on the shore 1,200 feet distant from the channel. The channel and a part of the sheltered area are to be dredged to a depth of 21 feet and the old east jetty is to be completely removed. The pierheads, 340 linear feet of the old west jetty, and the new jetty construction are to be capped with concrete. The total estimated cost of the work is \$315,500.

In the spring of 1904 it was necessary to make an allotment of \$40,000 from the river and harbor act of April 28, 1904, for the maintenance of this harbor. This money has been expended in rebuilding about 490 linear feet of the shoreward end of the west jetty, which was in such a ruinous condition that it threatened to give way and to involve the destruction of the channel. This extension directly advanced the project and diminished proportionally the amount required for its completion.

The river and harbor act of March 3, 1905, appropriated \$68,500 and authorized contracts to be entered into for \$200,000 more for the completion of the new projects. Of this latter sum all but \$3,000 has now been appropriated.

With the funds appropriated by the river and harbor act of March 3, 1905, the crib foundation of two pierheads and two 123-foot by 24-foot substructure cribs in the extremity of the new jetty were completed.

Work has been in progress during the past year on a contract for building concrete superstructure on 582 linear feet of the west pier and on two pierheads at the entrance; also to construct a rubble-mound jetty on the east side of the entrance 1,800 feet long. Under this contract the concrete superstructure on the east and west pierheads and 228.5 linear feet of the west pier has been completed, and 1,110 linear feet of the east jetty has been built up to an average height of 5 feet above mean lake level.

The excavation necessary in connection with the execution of the project and for maintenance of channel has been done by the U. S. dredges *Maumee* and *Burton*.

The amount expended under the existing project to June 30, 1907, was \$113,026.57, of which amount \$43,791.10 was for maintenance.

The result of these expenditures has been to obtain a channel 200 feet wide and 20 feet deep at mean low water through the outer bar and jettied channel for a distance of three-fourths of a mile, and to complete 48 per cent of the work under contract.



A channel 8 feet deep extends to Milan 8 miles above the mouth. The water surface variations are similar to those at Sandusky Harbor.

There has been a marked reduction in freight rates since the project was inaugurated, but this has been due not only to the work at this particular harbor, but to that at the other harbors along the lakes and the improvements in the channels connecting, as is shown by the report of the traffic passing through the Sault Ste. Marie, and it is impracticable to determine how much of this reduction is due to this particular improvement.

The commerce of Huron for the calendar year 1906 amounted to 1,675,096 tons, a decrease of 44,454 tons from that reported for the calendar year 1905.

July 1, 1906, balance unexpended.....	\$172, 706. 22
Amount appropriated by river and harbor act approved March 2, 1907.....	16, 000. 00
Amount appropriated by sundry civil act approved March 4, 1907.....	47, 000. 00

235, 706. 22

June 30, 1907, amount expended during fiscal year:

For works of improvement.....	\$59, 808. 80
For maintenance of improvement.....	33. 30
	59, 842. 10

July 1, 1907, balance unexpended.....	175, 864. 12
July 1, 1907, outstanding liabilities.....	14, 367. 44

July 1, 1907, balance available.....	161, 496. 68
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July 1, 1907, amount covered by uncompleted contracts.....	86, 769. 41
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(See Appendix Q Q 4.)

5. *Vermilion Harbor, Ohio.*—Vermilion Harbor is at the mouth of Vermilion River, which empties into Lake Erie about 20 miles eastward from Sandusky.

The improvement of this harbor was first undertaken in 1836, when an appropriation of \$10,000 was made for the purpose. The original project provided for parallel jetties extending outward to 12 feet of water in the lake. The jetties were built, but the current only sufficed to maintain a channel of about 7 feet depth across the bar. In the natural condition of the harbor there was only about 2 feet of water at this place. Dredging was accordingly resorted to and the project enlarged to provide for a depth of 14 feet of water. This involved the removal of rock, and the project was never fully executed.

The total amount of money expended on the original project is \$133,277.55.

The only work now proposed is the maintenance of existing jetties in a durable and permanent manner, the timber superstructure to be removed down to the level of the water, the side walls of the cribs to be reenforced by a riprapping of heavy stone having a slope of 1 on 1½; these slopes to be carried up above the surface of the water so as to give the jetty a height of 5 feet; above water the heavy stone protection to be laid in the form of a pavement. The estimated cost of this work is \$42,350.

No work has been done during the past fiscal year.

Under the appropriation of \$15,000 in the river and harbor act of March 2, 1907, a contract has been awarded for completing the reen-



forcement and repair of the west jetty and so much of the east jetty as the funds available will permit.

The amount expended on the existing project for maintenance to June 30, 1907, was \$14,875.56.

The result of these expenditures has been to provide a channel 12 feet deep to the inner end of the piers. A channel of 8 feet extends to the Lake Shore Railroad bridge, one-half mile above. The water surface fluctuations are similar to those at Huron or Lorain.

The improvement has had little effect on freight rates, as the tonnage of the port is small.

The receipts and shipments for the calendar year 1906 amounted to 1,025 tons, a decrease of 7,185 tons from that reported for the calendar year 1905.

July 1, 1906, balance unexpended.....	\$1, 481. 88
Amount appropriated by river and harbor act approved March 2, 1907.....	15, 000. 00
	<hr/> 16, 481. 88
June 30, 1907, amount expended during fiscal year, for maintenance of improvement .....	1, 357. 44
July 1, 1907, balance unexpended.....	15, 124. 44
July 1, 1907, outstanding liabilities.....	45. 94
July 1, 1907, balance available.....	<hr/> 15, 078. 50

(See Appendix Q Q 5.)

6. *Lorain Harbor, Ohio.*—This harbor is within the mouth of Black River, where it enters Lake Erie, 25 miles west of Cleveland. In its natural condition the depth of water at the mouth of this river did not exceed 3 feet, but the river itself was navigable for a distance of 3 miles from its mouth for all vessels then in use upon the lake.

The first project, adopted in 1828, provided for the construction of parallel piers 200 feet apart, running out to a depth of 16 feet in the lake. This project was modified in 1873 and 1880. The piers have had to be rebuilt and extended from time to time, so as to keep pace with increasing requirements, and dredging has been resorted to to secure a greater depth than the natural currents would afford. The amount expended on this project was \$292,204.77.

The present project was adopted by the river and harbor act of March 3, 1899. The project in detail is given in full in the Annual Report of Chief of Engineers for 1898, pages 2718 to 2724, inclusive. It provides for the construction of two rubble-mound breakwaters converging toward the lake, having an opening between them at their outer extremities 500 feet in width and in prolongation of the axial line of the jettied channel. It also provides for repairing or rebuilding the jetties and for dredging the protected areas to a depth of 20 feet. The estimated cost is \$695,500.

The total expenditure authorized by the river and harbor act of March 3, 1899, was \$650,000, but that amount not being sufficient to secure the completion of the work at such prices as could be obtained by advertisement special authority was given in the river and harbor act of June 6, 1900, to enter into contract for such portion of the work as the funds available would allow, at a cost not to exceed a 10 per cent increase over the original estimates, and the funds required therefor were appropriated in the river and harbor act approved March 3, 1905, and sundry civil acts of March 3, 1905, and June 30, 1906. The act of March 2, 1907, authorized the expenditure of

\$15,000 in dredging the easterly side of Black River from the inner end of the easterly Government pier to East Erie Avenue Bridge.

There has been expended under the new project to June 30, 1907, \$508,666.85, of which amount \$11,506.11 was for maintenance during the past four years. Prior to that time the amounts expended for works of improvement and for maintenance were so involved that it would be impracticable to separate them.

With this expenditure a channel has been dredged to a depth of 20 feet between the piers and for 1,000 feet beyond. Under a continuous contract 365 feet of the west pier and all of the east pier (1,765 linear feet) have been rebuilt with concrete superstructure. The substructure cribs of both pierheads at the new harbor entrance are in place, and the concrete superstructure of west pierhead half completed.

The west breakwater has been built up to 4 feet above mean lake level for 300 feet and to — 8 feet for 1,200 feet. The east breakwater has been completed for 1,000 feet and built up to the water surface for 300 feet.

Under a contract for the repairs of the west pier the timber superstructure for 472 feet has been replaced by concrete.

The project is now 75 per cent completed. A channel of 20 feet depth also extends up the river to the steel plant, 3 miles above the mouth, and is maintained by local authorities.

The water-surface fluctuations are similar to those at Cleveland.

There has been a marked reduction in freight rates since the project was inaugurated, but this has been due not only to the work at this particular harbor, but to that at the other harbors along the lakes and the improvements in the channels connecting, as is shown by the report of the traffic passing through the Sault Ste. Marie; and it is impracticable to determine how much of this reduction is due to this particular improvement.

It is expected to complete the project with the funds available.

The commerce of Lorain for the calendar year 1906 amounted to 4,325,691 tons, an increase of 1,060,205 tons over that reported for the calendar year 1905.

July 1, 1906, balance unexpended.....	\$318, 015. 36
Amount appropriated by river and harbor act approved March 2, 1907.....	30, 000. 00
	<hr/> 348, 015. 36
June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$83, 741. 35
For maintenance of improvement.....	1, 861. 26
	<hr/> 85, 602. 61
July 1, 1907, balance unexpended.....	262, 412. 75
July 1, 1907, outstanding liabilities.....	14, 128. 07
	<hr/> 248, 284. 68
July 1, 1907, balance available.....	<hr/> 176, 365. 84

(See Appendix Q Q 6.)

7. *Cleveland Harbor, Ohio.*—The old harbor of Cleveland was originally entirely within the mouth of the Cuyahoga River, where the natural depth of the water was sufficient for the requirements of the time. The mouth of the river was obstructed by an extensive sand bar, across which a channel of varying location and uncertain

depth existed. Sometimes the mouth of the river would be entirely closed by the action of the waves and would remain so until a freshet in the river cut out a new entrance.

The first improvement was undertaken in 1825, and the plan contemplated straightening the channel so that it would lead more directly into the lake, and making the new location permanent by jetties to confine the water and concentrate the action of the current upon the bar. These jetties were built, repaired, extended, and, in part, rebuilt, and the channel was made deeper and maintained by dredging as necessity required; but there was no change in the general plan of improvement until 1875, at which time the total expenditure had been \$346,881.61.

In 1875 a project was adopted for a breakwater of timber cribs in 5 fathoms of water. The west breakwater was commenced in 1876 and completed in 1883, a total length of 7,130 feet. The east breakwater was commenced in 1888 and continued at intervals until 1893, when its length was 2,494.5 feet. In 1895 an opening of 200 feet was made in the shore arm of the west breakwater as a sanitary measure.

In 1896 Congress authorized the completion of the improvement at a total estimated cost not to exceed \$1,354,000, in accordance with a project published in Annual Report of the Chief of Engineers for 1896, pages 2949 to 2953, inclusive. This project involved the completion of the east breakwater, covering an extension of about 3,000 feet; removing superstructure of the old west breakwater to a depth of 2 to 3 feet below water level and replacing it with a superstructure of concrete masonry; reenforcing the cribs below the masonry; sheathing the face of the east breakwater; removing and rebuilding the east and west piers and widening the mouth of the river. A continuous contract for the work was authorized.

In 1899 a project was prepared, and was authorized by the river and harbor act of that year, for deepening the channel and sheltered area by dredging to a depth of 21 feet. This project was enlarged by the act of June 13, 1902, to permit the dredging to be carried to a depth of 25 feet. The estimated cost of the work was \$478,400. (See Annual Report of the Chief of Engineers for 1899, pp. 3076 to 3078, inclusive, for project, and p. 3061 for estimate as revised.)

The river and harbor act of June 13, 1902, authorized a further modification of the project by providing for improving and enlarging the entrance to the harbor and for extending the breakwater eastward to Gordon Park, in the city of Cleveland, a distance of about 16,000 feet, at a total estimated cost of \$4,481,456. This project is described in the Annual Report of the Chief of Engineers for 1901, pages 3277 to 3299, inclusive. The act authorized an expenditure of \$2,800,000 (of which \$612,500 is yet to be appropriated), under the project, but this authorization was increased by \$900,000, not yet appropriated, in the river and harbor act of March 2, 1907, which also appropriated \$98,000 for the construction of a Government dock at the foot of Erie street in the city of Cleveland, in accordance with plan printed in House Document No. 270, Fifty-ninth Congress, second session, contingent upon the consent of the Cleveland Yacht Club, which holds a lease of this frontage.

The existing project for improving Cleveland Harbor, Ohio, is therefore a combination of those authorized by the acts of 1875, 1896, 1899, 1902, and 1907.

There has been expended on this project to June 30, 1907, \$4,746,-447.71, of which amount \$402,505.43 was for maintenance during the past four years. Prior to that time the amounts expended for works of improvement and for maintenance were so involved that it would be impracticable to separate them.

With this expenditure the mouth of the river has been widened, the east and west piers rebuilt and capped with concrete, with the exception of a small amount of jetty extension and dredging near the mouth of the Cuyahoga River and south of the Lake Shore Railway bridge, which has not been carried out because the United States has been unable to obtain title to the land which would have to be dredged away. The superstructure of the west breakwater has been removed and replaced by concrete masonry, and the lake face of the cribs protected with riprap. The old east breakwater has been repaired and extended as provided for in the project of 1896, with the exception of about 270 feet, which, being a portion of the shore arm, was not built on account of the modifications in the river and harbor act of June 13, 1902, which rendered its construction unnecessary.

The work at the new entrance and for the extension of the breakwater eastward is being carried on under continuous contracts. The two pierheads to mark the new entrance have been completed, and also about 51 per cent of the protection and two projecting breakwaters. On the breakwater extension work, the western division is about 81 per cent completed and the eastern division about 36 per cent.

From 1899 to 1904, 766,928 cubic yards of material was excavated in the harbor at a cost of \$115,000, but, as shown by the annual report of the district engineer for 1904, the deposit which took place over this area during this period has equaled or exceeded the amount of material removed, and the work done, therefore, must be regarded simply as maintenance work and not in advancement of the project.

Under an appropriation of \$200,000 by the river and harbor act of March 3, 1905, a contract was entered into for removing about 1,250,000 cubic yards in the harbor. During the past year the contractors removed 986,820 cubic yards, making a total of 1,237,400 cubic yards to June 30, 1907.

The U. S. dredge *Maumee* worked at Cleveland Harbor from October 8 to November 19, excavating 26,474 cubic yards from the east basin at a field cost of \$1,503.37.

As a result of these expenditures a navigable channel 20 feet in depth has been preserved at the mouth of the river and a large outer harbor constructed available for docks and anchorage. Cuyahoga River has a navigable depth of 20 feet to Jefferson street, 4 miles above its mouth and 16 feet for  $1\frac{1}{2}$  miles farther, and is maintained by local authorities.

There has been a marked reduction in freight rates since the project was inaugurated, but this has been due not only to the work at this particular harbor, but to that at the other harbors along the lakes and the improvements in the channels connecting, as is shown by the report of the traffic passing through Sault Ste. Marie, and it is impracticable to determine how much of this reduction is due to this particular improvement.

The sum of \$700,000 can be profitably expended in the fiscal year ending June 30, 1909, for the extension of the east breakwater and construction of the new entrance, which is required to extend the benefits already given.

The commerce of Cleveland Harbor for the calendar year 1906 amounted to 12,247,626 tons, an increase of 827,829 tons over that reported for the calendar year 1905.

The usual variation in the level of the water surface during the season of navigation is from 1 foot above to 2 feet below mean lake level. Fluctuations due to wind are about 2 feet.

NEW ENTRANCE, BREAKWATER EXTENSION, ETC., ACT JUNE 13, 1902.

July 1, 1906, balance unexpended.....	\$753, 499. 63
Amount appropriated by sundry civil act approved March 4, 1907.....	200, 000. 00
	<hr/>
June 30, 1907, amount expended during fiscal year, for works of improvement.....	953, 499. 63
	<hr/>
July 1, 1907, balance unexpended.....	257, 174. 10
July 1, 1907, outstanding liabilities.....	<hr/>
	696, 325. 53
	60, 418. 29
	<hr/>
July 1, 1907, balance available.....	635, 907. 24
	<hr/>
July 1, 1907, amount covered by uncompleted contracts.....	1, 020, 633. 14
Amount (estimated) required for completion of existing project.....	2, 293, 956. 00
	<hr/>
{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907.....	a 700, 000. 00
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

UNDER CONTRACTS, ETC., AUTHORIZED BY ACT OF JUNE 3, 1896.

July 1, 1906, balance unexpended.....	\$68, 929. 66
June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$16, 073. 26
For maintenance of improvement.....	3, 562. 96
	<hr/>
	19, 636. 22
July 1, 1907, balance unexpended.....	<hr/>
July 1, 1907, outstanding liabilities.....	49, 293. 44
	406. 37
	<hr/>
July 1, 1907, balance available.....	48, 887. 07

MAINTENANCE (DREDGING) AND CONTINUING IMPROVEMENT.

July 1, 1906, balance unexpended.....	\$189, 316. 84
Receipts from sales.....	49. 15
Amount appropriated by river and harbor act approved March 2, 1907.....	223, 000. 00
	<hr/>
	412, 365. 99
June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$105, 016. 20
For maintenance of improvement.....	2, 677. 20
	<hr/>
	107, 693. 40
July 1, 1907, balance unexpended.....	<hr/>
July 1, 1907, outstanding liabilities.....	304, 672. 59
	9, 325. 20
	<hr/>
July 1, 1907, balance available.....	295, 347. 39
	<hr/>
July 1, 1907, amount covered by uncompleted contracts.....	21, 769. 31
Amount (estimated) required for completion of existing project.....	203, 000. 00

(See Appendix Q Q 7.)

<sup>a</sup> Of this amount \$500,000 is for work under contract authorization of 1902 and \$200,000 under that of 1907.

8. *Fairport Harbor, Ohio.*—This harbor is situated at the mouth of Grand River, where it enters Lake Erie, about 29½ miles eastward from the harbor of Cleveland. Before the improvement was undertaken the depth across the bar at the mouth of the river was variable and uncertain and quite insufficient for the needs of commerce.

The first improvement was undertaken in 1825, and the original project provided for the construction of parallel jetties of cribwork filled with stone, placed about 200 feet apart and extending outward across the bar and into the lake. The jetties were extended from time to time until the west jetty attained a length of 2,370 feet and the east jetty 1,765 feet from the original shore line. These jetties have been repeatedly repaired and rebuilt as necessities required, and the channel has been deepened and redredged many times.

By the river and harbor act of June 3, 1896, the existing project for this improvement was adopted. This project is described in the Report of the Chief of Engineers, 1896, pages 2956 to 2958, inclusive, and provides for the construction of two breakwaters converging toward the lake, the outer ends being in deep water, and sufficient space being left between them to afford an easy entrance to the jettied channel. The breakwaters were to terminate in pierheads 50 feet square, the west breakwater to have a length of 2,050 feet and the east breakwater 1,350 feet. The estimated cost of the work, including dredging between the breakwaters to a depth of 20 feet, was \$510,000, which was revised to \$585,000 in 1900. (See Annual Report of the Chief of Engineers for 1900, pp. 4071–4072.)

A further modification of the project occurs in the river and harbor act of March 3, 1905, which provides that the westerly arm of the breakwater may be extended to a point at or near the shore, the expense thereof to be paid from the appropriations therein and theretofore made. The estimated cost of this extension was \$120,000.

The act of 1896, however, appropriated \$30,000, of which amount only \$20,000 was allotted for beginning the improvement, and the commencement of the project was deferred until, by the river and harbor act of March 3, 1899, \$100,000 was appropriated, all funds available to that period having been applied to maintenance of the old project.

The total expenditures to June 30, 1899, on the original project, were \$378,808.86.

The river and harbor acts of June 13, 1902, and March 3, 1905, provided not only for continuing existing project but for maintenance of the old work. From the various appropriations since 1899 there have been expended \$194,921.10 in repairs to old piers and dredging. With these funds 580 linear feet of the shoreward end of the east jetty was completely rebuilt of timber cribs with a concrete top, and 570 linear feet of the west jetty was extensively repaired with tongued and grooved piling below the water and with concrete and stone above, and the outer portion of both jetties was protected below water by a sheathing of hard-wood plank, and the wooden superstructure was completely repaired.

This harbor suffers greatly from the extensive movement of sand which constantly re-forms the bar at the outer end of the jetties, and extensive dredging has also been required.

With the funds available for continuing the improvement, 828 linear feet of the shoreward end of the west breakwater, as provided

for in the report of 1896, has been built and a contract is being executed for connecting this breakwater with the shore by a rubble-mound structure. Seventy-four per cent of this contract has been completed, 44 per cent having been done during the past year.

There has been expended on the existing project to June 30, 1907, \$385,947.50, of which amount \$119,805.94 was for maintenance during the past four years. Prior to that time the amount expended for works of improvement and for maintenance was so involved that it would be impracticable to separate them.

The water-surface variations are similar to those at Cleveland.

The result of these expenditures has been to obtain a channel 20 feet deep across the bar at the mouth of the river and to protect the entrance from westerly storms. A channel of 20 feet depth extends up the Grand River to Richmond, a distance of 1 mile from its mouth, and is maintained by local authorities.

There has been a marked reduction in freight rates since the project was inaugurated, but this has been due not only to the work at this particular harbor, but to that at the other harbors along the lakes and the improvements in the channels connecting, as is shown by the report of the traffic passing through the Sault Ste. Marie, and it is impracticable to determine how much of this reduction is due to this particular improvement.

The commerce of Fairport Harbor for the calendar year 1906 amounted to 2,575,018 tons, a decrease of 105,155 tons from that reported for the calendar year 1905.

July 1, 1906, balance unexpended.....	\$133, 877. 98
Amount appropriated by river and harbor act approved March 2, 1907 .....	100, 000. 00
Collections on account of damages to dredge <i>Burton</i> .....	106. 94
	<hr/> 233, 984. 92
June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$44, 887. 90
For maintenance of improvement.....	2, 911. 45
	<hr/> 47, 799. 35
July 1, 1907, balance unexpended.....	186, 185. 57
July 1, 1907, outstanding liabilities.....	10, 377. 67
	<hr/> 175, 807. 90
July 1, 1907, balance available.....	<hr/> 175, 807. 90
July 1, 1907, amount covered by uncompleted contracts.....	37, 705. 78
Amount (estimated) required for completion of existing project...	245, 000. 00
(See Appendix Q Q 8.)	

9. *Ashtabula Harbor, Ohio.*—This harbor is situated at the mouth of the Ashtabula River, where it enters Lake Erie, at a point about 56½ miles eastward from the harbor of Cleveland. In its natural condition the mouth of the river was obstructed by a bar upon which the depth of water varied according to the prevailing conditions of storms on the lake and freshets in the river. The greatest possible depth on the bar was 9 feet, this being the distance to the underlying rock near the shore line. The minimum depth probably did not exceed 2 feet.

The original project for the improvement of this harbor was adopted in 1826 and provided for the construction of two parallel jetties extending outward into the lake. These jetties have been built and repaired from time to time and extended farther into the



lake, and the channel has been deepened by dredging to meet the increasing demands of commerce, the project being modified accordingly.

The total amount expended on the original project was \$564,382.62.

The existing project was adopted under the authority of the river and harbor act of 1896 and is described in the Report of the Chief of Engineers for 1895, pages 3122 to 3216, inclusive, and provides for the construction of two breakwaters, each 1,500 feet long, and two pierhead cribs, at an estimated cost of \$465,000.

The river and harbor act of March 3, 1899, authorized a continuous contract to be made for the construction of these breakwaters, at a cost not to exceed \$430,000.

The river and harbor act of March 3, 1905, authorized the expenditure of the unexpended balance on hand to the credit of the improvement for the extension of the west breakwater to a point at or near the shore, and the funds have been applied toward the prolongation of the west breakwater 1,500 feet.

A contract is now in force for constructing the east and west breakwaters, and also for extending the west breakwater shoreward. Work under these contracts has been progressing very slowly. After completing about 65 per cent of the work on the east and west breakwaters the contractors failed and the work has been assumed by their sureties, who have completed 12 per cent additional.

The contract for extending the west breakwater shoreward is about 60 per cent completed, 24 per cent having been done during the year.

The amount expended on the existing project to June 30, 1907, is \$565,343.99, of which amount \$17,046.93 was for maintenance during the past four years. Prior to that time the amounts expended for works of improvement and for maintenance were so involved that it would be impracticable to separate them.

The project is now 73 per cent completed.

In 1904 the Secretary of War, under authority of law, gave permission to the Pittsburgh, Youngstown and Ashtabula Railroad Company to completely remove the west jetty and to replace the same by a bulkhead 60 feet farther to the west, thus increasing the width of the channel. Under the authority granted by this permit the railroad company has completed 1,120 feet of new dock, composed of stone-filled timber-crib substructure and concrete superstructure, and has made an extensive fill on the lake front and to the westward of the new dock, reclaiming about 16 acres; and the Government pier has been removed to a depth of 18 feet.

In May, 1906, authority was also granted to the Lake Shore and Michigan Southern Railway Company to make certain improvements on the easterly side of the river. The railway company is to take possession of the east pier and to extend it northward 720 feet. Thence, there will be an extension of about 900 feet easterly; thence southward to meet the property of the railway company. The inclosure will be filled to the level of the dock. The Government east breakwater will afford but partial protection to these new docks. The railroad company has been authorized to extend the east breakwater to protect its docks. Work on this improvement was begun in June, 1906, and has been vigorously prosecuted during the past year.



As a result of these expenditures the depth across the bar at the mouth of the river has been increased to 20 feet and an outer harbor has been provided. A 20-foot channel extends up the river  $1\frac{1}{2}$  miles above its mouth and is maintained by the local authorities.

The water-surface variations are similar to those at Cleveland.

There has been a marked reduction in freight rates since the project was inaugurated, but this has been due not only to the work at this particular harbor, but to that at the other harbors along the lakes and the improvements in the channels connecting, as is shown by the report of the traffic passing through the Sault Ste. Marie; and it is impracticable to determine how much of this reduction is due to this particular improvement.

The commerce of Ashtabula Harbor for the calendar year 1906 amounted to 10,314,129 tons, an increase of 1,063,438 tons over that reported for the calendar year 1905.

July 1, 1906, balance unexpended .....	\$307, 263. 56
Amount appropriated by river and harbor act approved March 2, 1907.....	20, 000. 00
Receipts from sales .....	6. 00
	<hr/>
	327,269.56
June 30, 1907, amount expended during fiscal year:	
For works of improvement .....	\$63, 004. 01
For maintenance of improvement.....	1, 389. 10
	<hr/>
	64, 393. 11
July 1, 1907, balance unexpended.....	262, 876. 45
July 1, 1907, outstanding liabilities.....	14, 458. 65
	<hr/>
July 1, 1907, balance available.....	248, 417. 80
July 1, 1907, amount covered by uncompleted contracts.....	183, 370. 88

(See Appendix Q Q 9.)

*10. Conneaut Harbor, Ohio.*—Conneaut Harbor is at the mouth of Conneaut Creek, in the northeastern part of the State of Ohio, and  $69\frac{1}{4}$  miles east of Cleveland. In its natural condition the creek was obstructed by a bar at its mouth, over which the average depth of water did not exceed 2 feet.

The first improvement was undertaken in 1829 and consisted in the construction of parallel jetties of timber cribs filled with stone. Only a moderate degree of improvement was sought, and the greatest depth ever obtained under this project through the action of these jetties did not exceed 12 feet.

No appropriations at all were made for this harbor from 1880 to 1892. At the end of this period the jetties were in a decayed and ruinous condition, and the channel had filled up with sand and silt, and had practically reverted to its original condition. The harbor could only be used by small sailing craft, such as were then engaged in fishing.

In 1892 a project was prepared which provided for the construction of parallel jetties 200 feet apart and extending outward to a depth of 17 feet in the lake, and appropriations under this project were made to 1896.

Expenditures on the early projects were \$112,448.47.

The existing project was authorized by the river and harbor act of June 3, 1896, and is described in the Annual Report of the Chief of Engineers for 1896, pages 2970-2972, inclusive. This project provides for the completion of the jetties to a depth of 17 feet in the lake, and the construction of two detached breakwaters converging toward the lake and designed to shelter the entrance to the jettied channel, and for securing a navigable depth of 20 feet in the channel and sheltered area.

The estimated cost of the work was \$610,000, exclusive of maintenance.

After \$220,000 had been appropriated, an expenditure under a continuous contract of \$450,000 was authorized by the river and harbor act of June 13, 1902. The river and harbor act of March 3, 1905, provides an addition of \$60,000 for continuing the improvement and for maintenance.

The total amount expended on existing project to June 30, 1907, is \$690,701.01, of which amount \$16,798.09 was for maintenance during the past four years. Prior to that time the amounts expended for works of improvement and for maintenance were so involved that it would be impracticable to separate them.

With these funds the project has been completed, 256 feet of the east breakwater having been constructed during the past year.

Some shoaling occurred in this harbor during the winter months, and the U. S. dredge *Burton*, between May 10 and 23, restored the usual width and depth to the channel, removing about 14,291 cubic yards of material.

As a result of these expenditures a depth of 20 feet has been obtained across the bar at the mouth of the creek and an outer harbor has been constructed. A 20-foot channel extends up the river one-half mile above its mouth, and is maintained by local authorities.

The water-surface variations are similar to those at Cleveland.

There has been a marked reduction in freight rates since the project was inaugurated, but this has been due not only to the work at this particular harbor, but to that at the other harbors along the lakes and the improvements in the channels connecting, as is shown by the report of the traffic passing through the Sault Ste. Marie; and it is impracticable to determine how much of this reduction is due to this particular improvement.

Sufficient funds are available from the unexpended balance of the appropriation for the maintenance of this work during the fiscal year ending June 30, 1909.

The commerce of Conneaut Harbor for the calendar year 1906 amounted to 7,063,069 tons, an increase of 506,787 tons over that reported for calendar year 1905.

July 1, 1906, balance unexpended-----	\$136,822.91
Amount appropriated by river and harbor act approved March 2, 1907-----	20,000.00
Receipts from sales-----	.13
	<hr/> 156,823.04
June 30, 1907, amount expended during fiscal year:	
For works of improvement-----	\$87,870.18
For maintenance of improvement-----	2,554.12
	<hr/> 90,424.30
July 1, 1907, balance unexpended-----	66,398.74
July 1, 1907, outstanding liabilities-----	11,463.53
	<hr/> 54,935.21
July 1, 1907, balance available-----	
July 1, 1907, amount covered by uncompleted contracts-----	11,357.58
(See Appendix Q Q 10.)	

11. *Removing sunken vessels or craft obstructing or endangering navigation.*—(a) *Car ferry Shenango No. 1.*—This vessel burned and sank while held in the ice outside of the harbor of Conneaut, Ohio, on March 29, 1904. It contained 26 empty steel cars.

A contract was awarded in June, 1904, for removal of the wreck for the value of the salvage. This contract was annulled in the spring of 1905. New proposals were invited and contracts entered into August 5, 1905, for removal of the wreck for the sum of \$9,800.

There has been expended to June 30, 1907, \$9,803.75.

The contractors completed the removal of the wreck in June, 1907.

(b) *Tow barge Yukon.*—This vessel foundered and sank off the harbor of Ashtabula, Ohio, on October 20, 1905, about 1 mile distant from the entrance. Soon after sinking it was struck by a steamer which carried away both of the masts. Upon examination in the spring of 1906 it was found that there was a minimum depth over it of 25 feet. Removal of the wreck to a depth of 30 feet was accomplished under a verbal agreement during the month of July, 1906, at a cost of \$400.

(c) *Steamer Lucille.*—This vessel foundered and sank 3.1 miles east-northeast from the Toledo light on August 9, 1906. Its removal was accomplished by contract in December, 1906, at a cost of \$1,400.

(d) *Schooner Algeria.*—This vessel foundered and sank off Cleveland Harbor, Ohio, 1 mile north of the main entrance, on May 9, 1906. Removal to a depth of 28 feet was accomplished by contract in October, 1906, at a cost of \$1,000.

(e) *Schooner Wm. Crosthwaite.*—This vessel foundered and sank in the passage south of Kelley Island, about 4 miles from Marblehead light-house, on September 4, 1906. An allotment of \$2,000 was made for its removal, which was done by the U. S. dredge *Maumee* in November, 1906.

(f) *Steamer City of Concord.*—This vessel foundered and sank 7 miles east of Marblehead light-house on September 30, 1906. Removal of wreckage to depth of 30 feet was done by the U. S. steamer *Visitor* during November, at a cost of \$100.

(g) *Tug McCormick.*—This vessel, which was carried out into the lake by the ice in January, 1907, was later raised and taken into the Grand River at Fairport, Ohio, by the owners and allowed to sink on the east bank of the channel opposite the warehouse of the Balti-

more and Ohio Railway Company. An allotment of \$1,500 was made for the removal of the wreck, and steps are under way to accomplish this result by contract.

(See Appendix Q Q 11.)

EXAMINATIONS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF  
MARCH 3, 1905.

Reports on preliminary examinations required by the river and harbor act approved March 3, 1905, of the following localities within this district were duly submitted by the district officer. They were reviewed by the Board of Engineers for Rivers and Harbors, pursuant to law, and were transmitted to Congress and printed in documents as indicated:

1. *Preliminary examination of Ashtabula Harbor, Ohio, with a view to the extension of the easterly arm of the breakwater.*—Report dated May 19, 1906, is printed in House Document No. 86, Fifty-ninth Congress, second session. It is not deemed advisable at this time for the United States to undertake the proposed extension of the breakwater.

2. *Preliminary examination of Cleveland Harbor, Ohio, with a view to obtaining wharf room for the storage of material and plant and other Government property.*—Report dated September 20, 1905, is printed in House Document No. 270, Fifty-ninth Congress, second session. The plan presented is estimated to cost \$98,000.

IMPROVEMENT OF ERIE HARBOR, PENNSYLVANIA, AND OF CERTAIN  
RIVERS AND HARBORS IN WESTERN NEW YORK.

This district was in the charge of Col. H. M. Adams, Corps of Engineers.

1. *Harbor at Erie, Pa.*—In its original condition the harbor of Erie was nearly landlocked, the only entrance being at the east end through a channel which was narrow and tortuous, variable in position, with a depth of about 6 feet.

The original project approved March 26, 1824, provided for closing the eastern end of the harbor by means of a breakwater, in which there should be an opening 200 feet wide, and for extending to deep water in the lake two parallel piers, one on each side of the opening. The project also included the necessary work of dredging to keep the channel open, making the necessary repairs to existing structures, and maintaining the Presque Isle Peninsula.

The project was modified by the river and harbor act of March 3, 1899, to require the harbor basin and entrance channel to be dredged to a depth of 20 feet at mean lake level, the north and south piers to be provided with concrete superstructure and extended 500 and 1,000 feet, respectively, and, conditionally, as stated in House Document No. 70, Fifty-fifth Congress, first session, four protection jetties to be built along the outer shore of Presque Isle Peninsula.

The estimated cost of completing the modified project was \$377,000.

At the beginning of the past fiscal year, under the modified project, 1,210 feet of wooden superstructure on north pier had been replaced with concrete, the north pier had been extended 510 feet, two pro-

tection jetties had been built, the channel dredged 20 feet deep, the dredging of the basin 20 feet deep nearly completed, and the wooden superstructure on all of the south pier (1,217 feet) had been replaced with concrete.

During the fiscal year the dredging of the basin has been completed and the south pier has been extended 500 feet.

Replacing with concrete the old timber superstructure on 750 feet of north pier is now in progress.

Work proposed for the ensuing fiscal year includes the further extension of the south pier 500 feet, the completion of the 750 feet of concrete superstructure on the north pier, the replacing with stone superstructure of 1,200 linear feet of timber superstructure on the south breakwater damaged by storm of January 20, 1907, maintenance of channels and structures and necessary protection to Presque Isle Peninsula; all for the purpose of making the improvement available, and for extension of benefits.

The total amount expended on the harbor to June 30, 1907, was \$1,270,861.34. It is impracticable to separate the cost of construction and maintenance.

The maximum draft that could be carried June 30, 1907, at mean lake level over the shoalest part of the locality under improvement was 19 feet, and the usual variation of level of water surface is about 2 feet.

The project is reported to have a material effect in controlling freight rates on bulk commodities—such as coal, grain, lumber, and ore.

The following table gives the total arrivals and departures, including tonnage, for the past ten years:

Year.	Number.	Tonnage.	Year.	Number.	Tonnage.
1897.....	3,133	4,051,984	1902.....	2,809	3,873,784
1898.....	2,939	3,939,019	1903.....	2,423	3,503,628
1899.....	3,200	3,961,794	1904.....	1,996	2,890,821
1900.....	2,709	3,403,312	1905.....	2,632	4,134,459
1901.....	3,405	3,204,325	1906.....	2,579	4,477,764

For more extended information and photographs, see Annual Report of the Chief of Engineers for 1900, page 4100 et seq., and for 1903, page 2115 et seq.; and for list of surveys, see page 3239, Report of the Chief of Engineers for 1897.

A chart of Erie Harbor is issued in the series of charts of the survey of the Northern and Northwestern Lakes, index Ec 2.

July 1, 1906, balance unexpended.....	\$100,355.00
Amount appropriated by river and harbor act approved March 2, 1907 .....	120,000.00
	<hr/> 220,355.00
June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$28,343.79
For maintenance of improvement.....	21,282.43
	<hr/> 49,626.22
July 1, 1907, balance unexpended.....	170,728.78
July 1, 1907, amount covered by uncompleted contracts.....	86,355.86
(See Appendix R R 1.)	

2. *Harbor at Dunkirk, N. Y.*—This is an artificially protected harbor lying in an indentation of the south shore of Lake Erie, between Point Gratiot on the west and Battery Point on the east. The distance between these points is 9,600 feet, and the maximum breadth of the indentation is 3,600 feet.

The original depth of water was about 10 feet and 15 to 16 feet to underlying rock.

The project, approved November 30, 1870, provided for a detached breakwater 2,860 feet long, one part of which, 2,300 feet long, was to be nearly parallel with the shore; the other part, 560 feet long, to be nearly parallel with the axis of the entrance channel.

This breakwater and the pier already built were to form the harbor and the old channel was to be enlarged to 170 feet wide and 13 feet deep.

The project adopted by Congress and provided for by the river and harbor act of June 3, 1896, consisted in completing the breakwater as before planned by the addition of 360 feet to its eastern end and adding the channel arm 560 feet long, and in addition thereto dredging the entrance channel and a harbor basin, containing in all about 65 acres, to a depth at mean lake level suitable for vessels drawing 16 feet. This work was completed in 1898 at a total cost of \$389,060.55.

The total amount expended on the harbor to June 30, 1907, was \$969,278.57.

It is impracticable to separate the cost of construction and maintenance.

During the past fiscal year no work was done except minor repairs.

Work proposed for the ensuing fiscal year consists in placing the structures damaged by storm of January 20, 1907, in as good repair as practicable with the funds on hand.

The maximum draft that could be carried June 30, 1907, at mean lake level over the shoalest part of the locality under improvement was 16 feet, and the usual variation of level of water surface is about 2 feet.

Freight rates have not been affected by the project.

The following table gives the total arrivals and departures, including tonnage, for the past ten years:

Year.	Number.	Tonnage.	Year.	Number.	Tonnage.
1897.....	197	12,160	1902.....	143	33,435
1898.....	180	22,005	1903.....	237	64,803
1899.....	192	82,783	1904.....	117	5,128
1900.....	278	107,316	1905.....	115	9,502
1901.....	171	49,148	1906.....	111	11,310

For more extended information and map, see Annual Report of the Chief of Engineers for 1898, page 2748 et seq., and for reports of surveys, see page 3127, Report of Chief of Engineers for 1896, and page 4150, Report of Chief of Engineers for 1900.

A chart of Dunkirk Harbor is issued in the series of charts of the survey of the Northern and Northwestern Lakes, index Ea 8.

July 1, 1906, balance unexpended.....	\$21,911. 11
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	3,602. 30
July 1, 1907, balance unexpended.....	18,308. 81

(See Appendix R R 2.)

3. *Harbor at Buffalo, N. Y.*—Buffalo Creek was the original harbor of the port of Buffalo. In its original condition the entrance channel from the lake was shallow and frequently closed by a gravel bar. The original project for the improvement of this harbor was adopted in 1826, and provided at first for the construction of piers on the north and south sides of Buffalo Creek. Subsequently a masonry sea wall, 5,400 feet long, was built along the lake shore south of the harbor entrance, and a sand-catch pier of piles and stone, 879 feet long, built out from the shore.

Between 1868 and 1893 a detached breakwater, 7,600 feet long, was built of timber cribs about a half mile distant from the lake shore and parallel with it.

A shore arm about 4,000 feet long was projected in 1874 to extend to the south end of this breakwater, leaving an opening of 150 feet. Work on this was in progress when it was wrecked by storm in 1893.

A new project was adopted in 1895 on the recommendation of a Board of Engineer officers and consisted of the abandonment of the shore arm and the extension of the breakwater to Stony Point.

The report of the Board and details of its plans are published in the Annual Report of the Chief of Engineers for 1895, page 3153 et seq. The river and harbor act of June 3, 1896, added to the project of the Board by providing for the construction of a farther length of the sand-catch pier, extending it to the established pierhead line.

The river and harbor acts of June 6, 1900, and June 13, 1902, made special provision for deepening the entrance to Buffalo Harbor and the city ship canal. The entrance channel has been dredged 23 feet deep at mean lake level for a width of 200 to 300 feet for 2,200 feet outward from outer end of north pier, 150 feet wide between the piers to its inner end (junction of Buffalo River and city ship canal), except over an area of rock at that point, where the depth is from 21½ to 23 feet.

The project now in force for the improvement of Buffalo Harbor, adopted June 3, 1896, and modified by the emergency river and harbor act of June 6, 1900, and the river and harbor acts of June 13, 1902, March 3, 1905, and March 2, 1907, is as follows:

(a) To build an extension of the breakwater to Stony Point, leaving the necessary openings for the convenience of commerce.

(b) To extend the sand-catch pier to the established pierhead line.

(c) To build an arm 1,000 feet long to the Stony Point section of breakwater for the purpose of protecting the south harbor entrance.

(d) To maintain existing structures by strengthening timber-crib-concrete portions and by making repairs and replacing the wooden superstructure of the breakwater with concrete and stone when necessary, and to maintain the north entrance channel 23 feet deep at mean lake level.

(e) To dredge to a depth of 23 feet at mean lake level an area at south end of harbor sufficient to provide access to canals of Lackawanna Steel Company and Buffalo and Susquehanna Iron Company.

(*f*) To remove to a depth of 23 feet a shoal outside the main or north entrance to the harbor.

Of the above, items (*a*) and (*b*) have been completed, item (*c*) is now in progress, item (*d*) will be required indefinitely, and it is expected to complete items (*e*) and (*f*) during the present season.

During the fiscal year work on the south entrance arm has been continued and it is now nearly to water level.

Work of placing stone superstructure, sea slope, and riprap on 723 feet of south harbor section of breakwater was nearly completed and minor repairs were made to timber structures.

Work proposed for the ensuing fiscal year, for making improvements available, and for extension of benefits, consists in completing stone superstructure, sea slope, and riprap on south harbor section of breakwater; continuing work on south entrance arm; dredging at south end of harbor; removing shoal outside of north entrance to harbor; repairing timber portions of breakwater, and general maintenance of channels and structures.

The total amount expended by the United States on the improvement of Buffalo Harbor to June 30, 1907, was \$5,129,013.70. It is impracticable to separate the cost of construction and maintenance.

A good harbor has been obtained. The principal features are north and south piers and the entrance channel between them at the mouth of Buffalo Creek, in which most of the business of the port is done, and the outer breakwater system, consisting of four sections of breakwater of an aggregate length of 22,600 feet, inclosing an outer harbor  $4\frac{1}{2}$  miles long and over one-half mile wide. This breakwater system comprises 8,894 linear feet of breakwater of timber-crib-concrete type, 7,250 linear feet of stone or rubble-mound type, 723 feet of timber-crib-stone type; 1,910 linear feet of wrecked timber-crib rebuilding to timber-crib-stone type, and 3,823 feet of timber-crib type.

The maximum draft that could be carried June 30, 1907, at mean lake level over the shoalest part of the locality under improvement was 20 feet, except at the Stony Point end of the outer harbor basin, where the maximum draft is limited to 14 feet. The usual variation of level of water surface is from 3 to 4 feet, with maximum variation much greater.

Attention is called to the need of a storage ground, work yard, and slip for loading and unloading timber and other materials used in harbor construction. The Government has no place for storage and dockage of this character, and the rental of property for the purpose is neither feasible nor desirable in a crowded port like Buffalo. The cost of providing such adequate storage facilities is estimated at \$73,600, and it is recommended that the existing project be extended by Congress, so as to provide for these facilities at the cost stated.

The project is reported to have a material effect in controlling freight rates on bulk commodities, such as coal, grain, lumber, and ore.

The commerce of Buffalo is large. During the year 1906 arrivals and departures of vessels by lake and river aggregated in number 8,294 and in tonnage 13,876,759.

The arrivals and departures of canal boats by the Erie Canal were 5,666 in number, with a tonnage of 1,769,919.



The principal receipts by lake and river were wheat, corn, flour, oats, iron ore, lumber, copper, pig iron, glucose, lard, and pork. The total receipts amounted to 10,680,196 tons.

The shipments by lake were principally coal, sugar, salt, and cement and aggregated 4,888,142 tons.

For comparison, the following table is given, showing the arrivals and departures by lake and canal and the tonnage, for the past five years:

Year.	Lake.		Canal.	
	Number.	Tonnage.	Number.	Tonnage.
1902.....	9,814	11,656,280	6,550	833,619
1903.....	8,727	11,586,719	6,974	1,324,216
1904.....	7,375	10,783,980	5,182	988,725
1905.....	7,950	12,090,153	4,902	985,861
1906.....	8,294	13,876,759	5,666	1,769,919

Total shipments and receipts: 1905, 13,210,147 tons; 1906, 17,338,257 tons.

For more extended information and maps and photographs, see Annual Reports of the Chief of Engineers since 1897, and for reports of surveys see page 3153, Report of Chief of Engineers for 1895, and reference on page 703, Report of Chief of Engineers for 1906, printed in full in House Document No. 240, Fifty-ninth Congress, first session.

A chart of Buffalo Harbor is issued in the series of charts of the survey of the Northern and Northwestern Lakes, index Ea 1.

July 1, 1906, balance unexpended.....	\$235,219.66
Amount appropriated by river and harbor act approved March 2, 1907.....	533,436.00
Received from other sources.....	20.85
	<hr/> 768,676.51
June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$15,418.29
For maintenance of improvement.....	54,922.20
	<hr/> 70,340.49
July 1, 1907, balance unexpended.....	698,336.02
July 1, 1907, amount covered by uncompleted contracts.....	472,079.73
(See Appendix R R 3.)	

4. *Lake Erie entrance to Black Rock Harbor and Erie Basin, New York.*—The adopted project contemplates the formation, by dredging and rock removal, of a channel 2,300 feet long, 400 feet wide, and 23 feet deep at mean lake level, except where bed rock is found at a depth of 22 feet, from Buffalo main entrance channel to Erie Basin, and a branch channel and basin 1,920 feet long, 500 feet wide, and 23 feet deep at mean lake level, to Black Rock Harbor, at an estimated cost of \$814,643. The act of June 13, 1902, authorized the letting of a continuing contract in the sum of \$614,643, exclusive of amount appropriated, for completing the work.

The plan of improvement is printed in House Document No. 125, Fifty-sixth Congress, second session, and in the Annual Report of the Chief of Engineers for 1901, page 3345.

The work was begun April 30, 1903, under a continuing contract for the whole work, to be completed under certain conditions of contract on or before December 31, 1906.

The work was not completed on that date, and the time limit was waived for a reasonable period, the contractor to pay the extra expense incurred by reason of the extension of time.

At the close of the fiscal year the channel from Buffalo north entrance channel to Erie Basin was nearly completed and the basin 75 per cent excavated.

The total amount expended on the project to June 30, 1907, was \$588,976.01, all for works of improvement.

The maximum draft that could be carried over the shoalest part of the locality under improvement at mean lake level June 30, 1907, was 10 feet, and the usual variation of level of water surface from 3 to 4 feet, with maximum variation much greater.

For commercial statistics, see report on Buffalo Harbor, New York.

The locality is shown on a chart of Buffalo Harbor and Niagara River to the falls, issued in the series of charts of the survey of the Northern and Northwestern Lakes, index Ea 1, and on an index map facing page 2142, Annual Report of the Chief of Engineers for 1903.

Reference to survey is made on page 592, Report of the Chief of Engineers for 1900.

The project, being auxiliary to the improvement at Buffalo, has not, as a separate work, affected freight rates.

All the funds authorized for this work have been appropriated.

July 1, 1906, balance unexpended.....	\$551, 092. 65
June 30, 1907, amount expended during fiscal year, for works of improvement .....	325, 425. 66
July 1, 1907, balance unexpended.....	225, 666. 99
July 1, 1907, amount covered by uncompleted contracts.....	225, 204. 07

(See Appendix R R 4.)

5. *Buffalo entrance to Erie Basin and Black Rock Harbor, New York.*—The first appropriation, \$50,000, for this improvement was made March 3, 1899, and an appropriation of \$191,701.25 was made June 6, 1900, to complete the work.

The adopted project is to build a breakwater about 2,200 feet long, covering and protecting the entrance to Erie Basin and Black Rock Harbor and the lake front of Buffalo Harbor between the State structures known as the Erie Basin breakwater and the Bird Island pier.

The project has been completed and the breakwater is the northerly section of the outer breakwater system forming the outer harbor of Buffalo.

The amount expended to June 30, 1907, was \$238,436.81, of which \$236,278.10 was for construction and \$2,158.71 was for maintenance. No money was expended during the past fiscal year.

The maximum draft that could be carried over the shoalest part of the locality under improvement at mean water level June 30, 1907, was 20 feet, and the usual variation of level of water surface is from 3 to 4 feet, with maximum variation much greater.

For commercial statistics see report on Buffalo Harbor.

For more extended information see Annual Reports of the Chief of Engineers for 1897, page 3246 et seq., and for 1901, page 3324 et seq., and for report of survey see page 3246, Report of the Chief of Engineers for 1897.

The locality is shown on a chart of Buffalo Harbor and Niagara River to the falls, issued in the series of charts of the survey of the Northern and Northwestern Lakes, index No. Ea 1, and on an index map facing page 2143, Annual Report of the Chief of Engineers for 1903.

The project, being auxiliary to the improvement at Buffalo, has not, as a separate work, affected freight rates.

This breakwater is the most northerly section of the breakwater system protecting Buffalo Harbor.

July 1, 1906, balance unexpended.....	\$3, 264. 44
July 1, 1907, balance unexpended.....	3, 264. 44

(See Appendix R R 5.)

6. *Black Rock Harbor and channel, New York.*—Black Rock Harbor is in reality a canal built along the east bank of Niagara River, located partially between the main shore and Squaw Island, and having at its lower end a lock 36 feet wide by 200 feet long, and a depth of  $9\frac{1}{2}$  feet on miter sills at mean lake level. This harbor, or canal, is separated from the Erie Canal by a wall of stone and earth.

The object of the improvement is to provide a channel for deep-draft vessels between Buffalo and Tonawanda around the rapids at the head of Niagara River. This is to be accomplished by making a channel 200 feet wide and 23 feet deep at mean lake level, joining at the foot of Maryland street, Buffalo, the 23-foot channel now under contract, the proposed channel to extend westerly and northerly, through Black Rock Harbor and Erie Canal combined, to the present lock, where a ship lock of the requisite capacity is to be built, the channel to extend from the foot of the ship lock through the Niagara River to deep water above Tonawanda, 400 feet wide and 23 feet deep at mean river level. The estimated cost is \$4,500,000. The project contemplated a lock 600 feet in length and 60 feet in width between quoins; but in order to accommodate vessels of the largest size now in use and under construction which may desire to use it, the dimensions of the lock have been increased to 650 feet in length and 70 feet in width.

Continuing contracts were authorized by the river and harbor act of March 2, 1907, in the sum of \$1,000,000, yet to be appropriated, for prosecuting the project.

Report of survey is printed on page 3284 et seq. of report for 1904.

Lands and structures needed in the prosecution of the work have been granted to the United States by the State of New York, and a continuous contract has been made for the excavation of the southerly 6,400 feet, more or less, of the channel, to be completed December 31, 1908.

All the funds authorized for this excavation have been appropriated.

Plans and specifications for further channel excavation, and for construction of lock walls, have been prepared, and bids for channel excavation have been invited, to be opened July 1, 1907.

The total amount expended to June 30, 1907, was \$15,180.03.

The maximum draft that could be carried June 30, 1907, at mean lake level, over the shoalest part of the locality under improvement, was 8 feet, and the usual variation of water surface is from 3 to 4 feet.

The project, being auxiliary to the improvement at Buffalo, has not, as a separate work, affected freight rates.

The locality is shown on United States Lake Survey chart No. Ea 1.

For commercial statistics see report on Buffalo Harbor and on Tonawanda Harbor and Niagara River, New York.

July 1, 1906, balance unexpended.....	\$332,408.17
Amount appropriated by sundry civil act approved March 4, 1907.....	367,000.00
Amount appropriated by river and harbor act approved March 2, 1907.....	1,000,000.00
	<hr/>
	1,699,408.17
June 30, 1907, amount expended during fiscal year, for works of improvement.....	14,588.20
	<hr/>
July 1, 1907, balance unexpended.....	1,684,819.97
	<hr/>
July 1, 1907, amount covered by uncompleted contracts.....	656,496.59
Amount (estimated) required for completion of existing project..	2,800,000.00

(See Appendix R R 6.)

7. *Tonawanda Harbor and Niagara River, New York.*—In its original condition the navigation of Niagara River from Lake Erie to Tonawanda was obstructed by several reefs and shoals which materially limited the draft of vessels traversing it, and the river in some places had a very swift current. The water in the harbor between Tonawanda Island and the mainland was shoal.

The adopted project of April 11, 1888, as modified June 3, 1896, and June 13, 1902, is to remove obstructions, so as to make a channel 400 feet wide and 18 feet deep at mean river level from Lake Erie to the north line of North Tonawanda, including the dredging of Tonawanda Harbor to a depth of 18 feet.

The river and harbor act of March 2, 1907, also appropriated \$3,000 for removing wreck of steamer *Embury* from Niagara River, near Grand Island.

The project is completed except at the Buffalo waterworks intake pier, where the width of the channel is about 100 feet, and from the Tonawanda Iron and Steel Company's docks to the north line of North Tonawanda, where the depth is from 12 to 15 feet.

The amount expended to June 30, 1907, was \$652,756, all for improvement.

No work is proposed for the ensuing fiscal year.

The commerce of Tonawanda is large. During the year 1906 there were entered and cleared 1,802 lake craft, with a tonnage of 1,117,766 tons. The receipts were principally lumber, iron ore, and limestone, and aggregated 1,064,030 tons. The shipments from Tonawanda are entirely by Erie Canal.

The maximum draft that could be carried June 30, 1907, at mean water level, over the shoalest part of the locality under improvement, was 15 feet, and the usual variation of level of water surface is 2 feet.

A chart of Niagara River to the falls is issued in the series of charts of Northern and Northwestern Lakes, index Ea 1.

It is reported that the project has a material effect in controlling freight rates on bulk commodities, such as coal, grain, lumber, and ore.

For reports of surveys see page 2066, Report of Chief of Engineers for 1888, and page 4155, report for 1900.

July 1, 1906, balance unexpended.....	\$30, 262. 58
Amount appropriated by river and harbor act approved March 2, 1907.....	3, 000. 00
	<hr/> 33, 262. 58
June 30, 1907, amount expended during fiscal year, for works of improvement.....	318. 58
	<hr/> 32, 944. 00
July 1, 1907, balance unexpended.....	32, 944. 00
July 1, 1907, amount covered by uncompleted contracts.....	2, 655. 00
Amount (estimated) required for completion of existing project.....	497, 287. 93

(See Appendix R R 7.)

#### IMPROVEMENT OF HARBORS ON LAKE ONTARIO AND OF ST. LAWRENCE RIVER AND HARBORS THEREON, NEW YORK.

This district was in the charge of Col. H. M. Adams, Corps of Engineers.

*1. Harbor at Charlotte, N. Y.*—This harbor is at the mouth of the Genesee River. In its original condition vessels of more than 8 feet draft could not cross the bar.

The original project of 1829 was to secure a channel 12 feet deep across the bar by constructing parallel piers to confine and direct the action of spring freshets. The project of 1882 was to obtain a depth of 15 feet by extending the two piers a total of 3,250 feet and by dredging. After the piers had been extended 1,444 feet the project was modified July 18, 1896, to preserve the depth by dredging without further extension of the piers for the present, and March 2, 1897, it was again modified to obtain and maintain not less than 16 feet and not more than 16½ feet at low water (zero of Oswego gauge) in a channel not more than 200 feet wide.

The amount expended to June 30, 1907, was \$667,639.23. It is impracticable to separate the cost of construction and maintenance.

During the fiscal year 583 linear feet of the west pier and 240.5 linear feet of the east pier were reconstructed and the old timber superstructure replaced with concrete. Minor repairs were made and the channel maintained.

June 30, 1907, the maximum draft that could be carried in the channel at low water was 16 feet, and the usual variation of level of water surface is 3 feet.

The Genesee River is navigable for lake vessels for a distance of about 2½ miles above its mouth.

It is reported that the project has a material effect in controlling freight rates on bulk commodities, such as coal, grain, lumber, and ore.

The following is a statement of the commerce at this port during the past ten years in tons: 1897, 385,981; 1898, 483,850; 1899, 447,428; 1900, 399,605; 1901, 549,207; 1902, 557,690; 1903, 569,169; 1904, 554,212; 1905, 597,996; 1906, 432,709.

The work proposed for the ensuing fiscal year, to make the improvement available, is to make necessary repairs to piers and to dredge the channel.

For more extended information and map, see Annual Report of the Chief of Engineers for 1881, page 2436.

A chart of Charlotte Harbor is issued in the series of charts of the survey of the Northern and Northwestern Lakes, index On 1.

July 1, 1906, balance unexpended.....	\$33,002.35
Amount appropriated by river and harbor act approved March 2, 1907.....	88,500.00

121,502.35

June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	37,082.25
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July 1, 1907, balance unexpended.....	84,420.10
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(See Appendix S S 1.)

2. *Harbor at Pultneyville, N. Y.*—This harbor is at the mouth of Salmon Creek, which empties into Lake Ontario, in Wayne County, N. Y. In its original condition the depth was only 20 inches.

The original project in 1871 was to protect the approach to the creek by building two piers in the lake, of timber cribs filled with stones, and to dredge a channel from the 10-foot curve in the lake to the mouth of the creek to a depth of 10 feet at low water, at an estimated cost of \$59,000.

In 1875 the material to be dredged was found to be so hard that the estimated cost was increased to \$71,000.

The project is completed, except that a depth of 8 feet instead of 10 was obtained, the effort to secure the latter having been abandoned in 1900 on account of the difficult dredging. No work has been done since the season of 1900.

The amount expended to June 30, 1907, was \$79,011.84, of which \$70,607.96 was for construction and \$8,393.88 for maintenance.

June 30, 1907, the maximum draft that could be carried in the channel was 3 feet, and the usual variation is 3 feet.

Salmon Creek is navigable but a short distance above the inner end of the piers.

The project has had no effect on freight rates.

The commerce of Pultneyville, which is a village of about 300 inhabitants, is insignificant, there being only 4 arrivals and departures, with a tonnage of 188, during the year 1906.

Work proposed for the ensuing year, to make the improvement available, is to maintain, as far as funds will allow, the channel at 8 feet depth, and make necessary repairs to the piers.

For more extended information and map, see page 2460 et seq., Report of the Chief of Engineers for 1894.

Amount appropriated by river and harbor act approved March 2, 1907.....	\$6,000.00
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	11.84

July 1, 1907, balance unexpended.....	5,988.16
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(See Appendix S S 2.)

3. *Harbor at Great Sodus Bay, New York.*—In its original condition the channel connecting this bay with Lake Ontario was wide and impracticable for vessels drawing over 8 feet.

The original project of 1829 was to narrow the entrance by constructing two converging breakwaters and to secure a channel of 12

feet depth by building two parallel piers about 450 feet apart, connecting with the ends of the breakwater, and by dredging. The present project, of 1882, is to obtain a depth of 15 feet at low water (zero of Oswego gauge) by extending the two piers a total of 1,100 feet and by dredging. After the piers had been extended 519 feet to their present lengths—west pier, 1,580 feet; east pier, 1,294 feet—the project was modified July 18, 1896, to restore and maintain the channel 150 feet wide between the piers, flaring to 250 feet in the lake, to the requisite depth of 15 feet at low water, by dredging, without further extension of the piers for the present.

The amount expended to June 30, 1907, was \$497,453.68, of which \$89,201.88 was for maintenance.

During the fiscal year the channel between the piers was dredged to the depth of 14½ feet at low water under emergency allotment, and minor repairs to structures were made.

The minimum depth, June 30, 1907, was 14 feet at low water in a channel width of 150 feet, and the usual variation of level of water surface is 3 feet.

The project is reported to have a material effect in controlling freight rates on bulk commodities, such as coal, grain, lumber, and ore.

The following is a statement of commerce at this port for the past ten years, in tons: 1897, 36,361; 1898, 70,709; 1899, 78,885; 1900, 84,379; 1901, 84,379; 1902, 26,726; 1903, 18,875; 1904, 30,797; 1905, 46,251; 1906, 58,905.

For more extended information and map, see Annual Report of the Chief Engineers for 1881, page 2441 et seq.

A chart of Great Sodus Bay is issued in the series of charts of the survey of the Northern and Northwestern Lakes, index Om 3.

July 1, 1906, balance unexpended-----	\$1, 656. 01
Amount appropriated by river and harbor act approved March 2, 1907..	50, 000. 00

51, 656. 01

June 30, 1907, amount expended during fiscal year, for maintenance of improvement-----	\$1, 611. 89
Returned to Treasury to credit of emergency appropriation..	12. 00
	1, 623. 89

July 1, 1907, balance unexpended-----	50, 032. 12
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(See Appendix S S 3.)

4. *Harbor at Little Sodus Bay, New York.*—In its original condition the channel connecting this bay with Lake Ontario was about 150 wide and 18 inches deep.

The original project of 1854 was to protect the channel by building two parallel piers 250 feet apart across the bar to the 15-foot curve in the lake and to connect them with the shore by breakwaters. In 1867 this project was modified to provide for dredging to the depth of 12 feet. The present project, of 1882, is to obtain a depth of 15 feet at low water (zero of Oswego gauge) by extending the piers to the 15-foot curve in the lake, and by dredging. After the piers had been extended 835 feet to the following lengths—west pier, 1,747 feet; east pier, 1,510 feet—the project was modified June 29, 1898, to restore and maintain the entrance channel, 150 feet wide, to the requisite depth of 15 feet, by dredging, without further extension of

the piers for the present, and this was modified by the river and harbor act of June 13, 1902, to extend the east pier 300 feet, making its total length, 1,810 feet.

The amount expended to June 30, 1907, was \$395,138.54, of which \$93,775.74 was applied to maintenance of improvement.

During the fiscal year minor repairs to piers have been made and preparations made for replacing with concrete the timber superstructure on 2,208 feet of piers.

The minimum depth over the shoalest part of the locality under improvement, June 30, 1907, was 15 feet at low water in a channel width of 150 feet, and the usual variation of level of water surface is 3 feet.

The project is reported to have a material effect in controlling freight rates on bulk commodities, such as coal, grain, lumber, and ore.

The following is a statement of commerce at this port for ten years, in tons: 1897, 68,888; 1898, 50,339; 1889, 81,969; 1900, 59,511; 1901, 135,118; 1902, 52,543; 1903, 120,692; 1904, 137,258; 1905, 105,298; 1906, 103,991.

Work proposed for the ensuing year, necessary to make the improvement available, consists in maintenance of channels and piers.

For more extended information and map, see Annual Report of the Chief of Engineers for 1881, page 2443 et seq.

A chart of Little Sodus Bay is issued in the series of charts of the survey of the Northern and Northwestern Lakes, index OI 9.

July 1, 1906, balance unexpended.....	\$1, 688. 05
Amount appropriated by river and harbor act approved March 2, 1907.....	75, 000. 00
Received from other sources.....	20. 00

76, 708. 05

June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	2, 562. 86
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July 1, 1907, balance unexpended.....	74, 145. 19
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(See Appendix S S 4.)

5. *Harbor at Oswego, N. Y.*—This harbor comprises the lower part of Oswego River, a cove at its mouth, protected by a breakwater now known as the inner breakwater and an outer harbor formed by an outer breakwater. In its original condition the harbor in the Oswego River was navigable by vessels of light draft only, and the cove had no protection against the lake seas.

The original project of 1827 (completed in 1829) was to build across the cove a breakwater of timber cribs filled with stone. Between 1830 and 1838 a superstructure of masonry was built on 500 feet of this breakwater. Between 1866 and 1869 \$41,000 was expended in dredging the harbor to the depth of 12 feet at extreme low water. Between 1868 and 1870 a light-house pier was built, extending north 437 feet from the channel end of the breakwater. In 1871 the project for an outer harbor formed by an outer breakwater was adopted, and in 1881 an outer breakwater was completed having a lake face 4,870 feet long, a westerly shore return 916 feet long, and an easterly return 246 feet long. In 1881 a project was adopted to build an east breakwater, 248 feet of which was constructed in 1881 and removed in 1889. In 1885 and 1889 two spurs to the outer breakwater, 100 and 150 feet long, respectively, were built.



In the acts of March 3, 1893, and August 18, 1894, special provisions were made for extending the deep-water area of the harbor in the mouth of the Oswego River by the removal of rock.

The present project was adopted June 3, 1896, based on a special report printed in the Annual Report of the Chief of Engineers for 1895, page 3213 et seq., and as subsequently modified is, first, to build an east breakwater 1,435 feet long, at an estimated cost of \$197,000 (acts of March 3, 1895, and June 3, 1896); second, to narrow the breach made in the outer breakwater in 1884 from 175 to about 75 feet, at an estimated cost of \$18,500; third, to widen and deepen the inner harbor in the mouth of the Oswego River and to extend the deep-water area further upstream by rock excavation.

There are 5,907 feet of outer breakwater and 1,993 feet of inner breakwater and light-house pier, forming an outer harbor containing 140 acres and an inner harbor containing 9.35 acres (including the Oswego River). The areas having a controlling depth of 14.5 feet at low water are 40 acres in the outer harbor and  $4\frac{1}{2}$  acres in the inner harbor.

Under maintenance there is required: The maintenance of the outer breakwater and inner breakwater and light-house pier, the maintenance of a depth of 15.7 feet at low water in the entrance channel and in the outer harbor, and the maintenance of a depth of 15 feet at low water in the cove behind the inner breakwater and in the harbor in the mouth of Oswego River.

The plane of reference is low water (zero of Oswego gauge).

The outer breakwater is a weak structure, difficult and costly to maintain.

The river and harbor act of March 3, 1905, made an appropriation for continuing repairs under the present method, printed as plan "B," on page 3368, Report of the Chief of Engineers for 1904.

Under this appropriation extensive repairs were made to the outer breakwater during the fiscal year.

The river and harbor act of March 2, 1907, makes an appropriation of \$100,000 and authorizes contracts to the extent of \$100,000 additional, yet to be appropriated, for making further repairs under plan "A," printed on page 3368, Report of the Chief of Engineers for 1904, which contemplates a stone superstructure and sea slope, at an estimated cost of \$900,000.

The amount expended to June 30, 1907, was \$2,099,673.99. It is impracticable to separate the cost of construction and maintenance.

June 30, 1907, the minimum depth at low water over the shoalest part of the locality under improvement was  $14\frac{1}{2}$  feet.

The usual variation of level of water surface is 3 feet.

The project is reported to have a material effect in controlling freight rates on bulk commodities, such as coal, grain, lumber, and ore.

The following is a statement of the commerce of this harbor for the past ten years, in tons: 1897, 706,805; 1898, 615,503; 1899, 716,753; 1900, 575,160; 1901, 565,052; 1902, 334,009; 1903, 733,734; 1904, 712,481; 1905, 724,502; 1906, 615,840.

Work proposed for the ensuing fiscal year, necessary to make the improvement available and extend its benefits, consists in dredging on shoals as may be required in the outer harbor and entrance channel and repairs on the outer and inner breakwaters.

Report of survey of the outer breakwater is printed on page 3363 et seq. of the Report of the Chief of Engineers for 1904.

For more extended information and map, see Annual Report of the Chief of Engineers for 1881, page 2451 et seq.

A chart of Oswego Harbor is published in the series of charts of the survey of the Northern and Northwestern Lakes, index OI 7, and an index map facing page 2160 of the Annual Report of the Chief of Engineers for 1903.

July 1, 1906, balance unexpended.....	\$97,455.40
Amount appropriated by river and harbor act approved March 2, 1907.....	100,000.00
Received from other sources.....	4.55

June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	197,459.95
	73,448.52

July 1, 1907, balance unexpended.....	124,011.43
Amount (estimated) required for completion of existing project....	800,000.00

(See Appendix S S 5.)

6. *Harbor at Cape Vincent, N. Y.*—This harbor is an open roadstead on the St. Lawrence River,  $2\frac{1}{2}$  miles from Lake Ontario, and is a convenient location for vessels to lie during storms, at night, and in thick weather.

The original project of 1896 was to build a breakwater parallel to and 600 feet from the railroad wharf, 1,600 feet long, at an estimated cost of \$320,000. On May 13, 1899, this project was modified to build a breakwater parallel to and 500 feet from the railroad wharf, 1,550 feet long, of which length 150 feet, or so much thereof as required, was to be a shore return at upper end, at an estimated cost of \$200,000. Four hundred and ten feet of this breakwater, of which 50 feet was shore return, was built in 1900, 300 feet was finished in June, 1905, and 200 feet was completed in 1906.

The amount expended to June 30, 1907, was \$127,009.40, all for construction.

The maximum draft that could be carried over the locality under improvement at low water June 30, 1907, was 19 feet, and the usual variation of level of water surface is 3 feet.

The commerce of Cape Vincent is not large. This improvement is intended to make a harbor of refuge for all craft plying between Lake Ontario and the St. Lawrence River.

The following is a statement of the commerce of this port, in tons, for the years given: 1900, 10,721; 1901, 4,209; 1902, 4,175; 1903, 15,666; 1904, 20,083; 1905, 21,750; 1906, 112,501.

No work is proposed for the ensuing fiscal year.

For more extended information and map, see Annual Reports of the Chief of Engineers for 1897, page 3286 et seq., and for 1903, page 2162 et seq.

The project has provided facilities that make navigation more safe and thus affects freight rates.

July 1, 1906, balance unexpended.....	\$23,449.23
June 30, 1907, amount expended during fiscal year, for works of improvement.....	22,458.63

July 1, 1907, balance unexpended.....	990.60
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Amount (estimated) required for completion of existing project....	72,000.00
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(See Appendix S S 6.)

7. *Harbor at Ogdensburg, N. Y.*—In its original condition the low-water depth in this harbor was 9 feet in the upper entrance channel leading to the Oswegatchie River, 10 to 12 feet in the two lower entrance channels, and 6 to 12 feet along the city front.

The original project of 1868 was to dredge the channels to the depth of 12 feet and to build, if necessary, 5,500 linear feet of piers, at an estimated cost of \$100,000. The piers were never built. The project of 1882 provided for dredging the upper entrance channel from the St. Lawrence River channel across the shoal to and into the mouth of the Oswegatchie to 16 feet and the lower entrance channels and channels along the city front to 15 feet at extreme low water, at an estimated cost of \$75,000. The present project (see Annual Report of the Chief of Engineers for 1890, p. 2872) provided for dredging all the channels to a depth of 16.5 feet below the zero of the Ogdensburg gauge (15 feet below the zero of the Oswego gauge), at an estimated cost of \$158,950. The project was modified February 27, 1897, to deepen the two lower entrance channels to 16 feet below the zero of the Oswego gauge, and by act of March 3, 1899, further modified to dredge 900 feet of the channel along the front of Ogdensburg above Franklin street to but 14 feet below the same zero, the projected depths of the upper entrance channel to and into the mouth of the Oswegatchie River up to the bridge, and the balance of the channel along the city front to remain 15 feet. The dredging of all of the channels of the project was completed in July, 1903, but they are not stable, and frequent redredging is necessary to maintain the required depths.

The amount expended to June 30, 1907, was \$342,285.08, of which \$70,565.87 was applied to maintenance of improvement.

During the fiscal year the upper entrance channel has been dredged to a depth of 15 feet, under emergency allotment of June 6, 1906.

The maximum draft that could be carried over the improvement at low water (zero Oswego gauge) June 30, 1907, was as follows: In the lower entrance channels, 15 feet; in the upper entrance channel, 15 feet; in the channel along the city front, 12 feet. The usual variation of level of water surface is 3 feet.

The project is reported to have a material effect in controlling freight rates on bulk commodities, such as coal, grain, lumber, and ore.

The following is a statement of commerce at this port for the past ten years, in tons: 1897, 866,035; 1898, 645,201; 1899, 670,363; 1900, 646,248; 1901, 646,248; 1902, 837,025; 1903, 1,185,785; 1904, 898,257; 1905, 1,034,085; 1906, 1,056,100.

Work proposed for the ensuing fiscal year necessary to make the improvement available consists in dredging channels wherever necessary.

For more extended information and map see Annual Report of the Chief of Engineers for 1881, page 2451 et seq.

An index map is printed in the Annual Report of the Chief of Engineers for 1903, facing page 2166.

July 1, 1906, balance unexpended.....	\$10, 264. 14
Amount appropriated by river and harbor act approved March 2, 1907.....	75, 000. 00
	<hr/> 85, 264. 14
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	\$10, 193. 66
Returned to Treasury to credit of emergency appropriation .....	61. 71
	<hr/> 10, 255. 37
July 1, 1907, balance unexpended.....	75, 008. 77
(See Appendix S S 7.)	

8. *Removing sunken vessels or craft obstructing or endangering navigation.*—The hull of steamer *Massena* was removed from Ogdensburg Harbor under contract at a cost of \$500.

(See Appendix S S 8.)

EXAMINATION AND SURVEY MADE IN COMPLIANCE WITH RIVER AND  
HARBOR ACT OF MARCH 3, 1905.

Reports dated July 10, 1905, and May 21, 1906, required by the river and harbor act approved March 3, 1905, on *preliminary examination and survey of St. Lawrence River at or near Thousand Island Park, New York*, were submitted by the district officer and were reviewed by the Board of Engineers for Rivers and Harbors, pursuant to law. They were transmitted to Congress and printed in House Document No. 177, Fifty-ninth Congress, second session. Alternative plans for improvement are presented, but it is not deemed advisable for the United States to undertake the improvement of the locality at the present time.

IMPROVEMENT OF HARBORS IN CALIFORNIA SOUTH OF SAN  
FRANCISCO.

This district was in the charge of Capt. Amos A. Fries, Corps of Engineers. Division engineer, Col. W. H. Heuer, Corps of Engineers, until March 2, 1907, and Lieut. Col. John Biddle, Corps of Engineers, since June 12, 1907.

1. *San Diego Harbor, California.*—San Diego Harbor is just north of the national boundary of Mexico and 482 nautical miles south of San Francisco.

The river and harbor act approved March 3, 1875, appropriated \$80,000 for the construction of a dike across the mouth of San Diego River, causing it to empty into False Bay, and thus preventing San Diego Harbor from being injured by the deposit of material brought down during flood stages. This work was completed in 1876 at a cost of \$79,798.72, which, with the cost of repairs made up to the time of adoption of the present project, brought the total expenditures to \$81,918.45. Further repairs to the dike have been made by the city of San Diego.

The later project for the improvement of the harbor, adopted by the river and harbor act approved September 19, 1890, provided for the construction of a jetty on Zuninga shoal, at the entrance to the harbor; the maintenance of a channel 24 feet deep at mean low tide and 500 feet wide through the "middle ground," and for repairs to restraining dike. The jetty was to rise to the height of extreme high water and to be about 7,500 feet long, with a view to producing a depth of 26 feet at mean lower low water on the outer bar.

At the time of the adoption of this project the governing depth on the bar was 21 feet. Just inside the entrance was a middle ground carrying but 17 feet of water. The main channel, lying to the west of the middle ground, was of ample depth, but was difficult of navigation on account of two sharp turns.

The original estimated cost of this improvement was \$394,400. This estimate was increased in June, 1900, to \$542,850.

The appropriation of \$192,850 in the sundry civil act of March 3, 1903, brought the total of appropriations up to the amount of the revised estimate.

The jetty was extended to its full contemplated length of 7,500 feet, a channel 26 feet deep and 271 feet wide (28 feet deep over a width of 171 feet) was dredged across the outer bar, and a channel 26 feet deep and 400 feet wide was dredged across the middle ground. Later the channels through the outer bar and the middle ground both shoaled to 24 feet depth. The amount expended on this harbor up to the completion of this project was \$625,214.94.

The river and harbor act of March 3, 1905, appropriated \$10,000 for the maintenance of these channels.

On September 28, 1906, an emergency contract was entered into with the North American Dredging Company for dredging a channel through the outer bar to a depth of 28 feet and to such width as the amount of money available would permit. Fifteen thousand six hundred and twenty-five cubic yards of material was dredged and dumped at sea at a cost of 60 cents per yard. This contract was completed December 18, 1906. A channel 100 feet wide and 27 feet deep at mean lower low water was dredged. This channel has since shoaled to 25 feet depth, which is the maximum draft that could be carried into the harbor at mean lower low water on June 30, 1907. The average height of all high waters above the plane of reference is 4.8 feet.

The river and harbor act of March 2, 1907, appropriated \$20,000 for the maintenance of these channels, and a contract will be entered into at an early date with the North American Dredging Company for dredging about 37,254 cubic yards of material on the outer bar at 51 cents per yard.

The amount expended on this project (maintenance) to June 30, 1907, is \$10,079.19.

The commerce of this harbor was 216,761 tons for the calendar year 1906, an increase of 36 per cent over that of the previous year. It consists principally of lumber, general merchandise, and ore shipped. The value of this commerce is estimated to be \$10,523,498.

The coastwise trade is carried in vessels drawing from 12 to 20 feet of water, and is benefited but little by the improvement of the harbor. The American-Hawaiian steamers, of 8,000 to 10,000 tonnage each, enter this port once a month. These vessels draw about 26 feet of water and carry 1,000 to 2,000 tons of freight per month for San Diego. Freight for San Diego carried by the Panama steamers is delivered by coastwise steamers from San Francisco. The American-Hawaiian steamers and the Panama steamers have a rate from the Atlantic ports to San Diego averaging about 30 per cent cheaper than railroad rates. Foreign cements are received in this port in sailing vessels drawing 22 and 23 feet of water.

For reference to reports on examinations and surveys, see Annual Report of the Chief of Engineers for the year 1904, page 632.

July 1, 1906, balance unexpended.....	\$9,797.36
Amount appropriated by river and harbor act approved March 2, 1907.....	20,000.00
	<hr/> 29,797.36
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	9,738.23
	<hr/>
July 1, 1907, balance unexpended.....	20,059.13
July 1, 1907, outstanding liabilities.....	26.93
	<hr/>
July 1, 1907, balance available.....	20,032.20
(See Appendix T T 1.)	

2. *Deep-water harbor at San Pedro Bay, California.*—The river and harbor act of June 3, 1896, provided for the appointment of a Board to determine upon the location of a deep-water harbor for commerce and of refuge in Santa Monica Bay, California, or at San Pedro, in the same State, the decision of a majority of the Board as to location to be final. The Board was to make plans, specifications, and estimates for said improvement. After the Board should have rendered its decision and submitted its report the Secretary of War was empowered to make contracts for the completion of the selected harbor in accordance with the project of the Board, at a cost not exceeding in the aggregate \$2,900,000.

In accordance with the provisions of this act a Board was appointed which submitted its report March 1, 1897, deciding in favor of San Pedro Bay. The report of the Board is printed in Senate Document No. 18, Fifty-fifth Congress, first session.

The plan of the Board (the present project of improvement) was to construct, to the eastward of Point Fermin, a breakwater about 8,500 feet long, or as much longer as could be constructed within the authorized limit of cost, \$2,900,000, and it has been decided that a breakwater 9,000 feet long should be built. In plan the breakwater is to consist of two straight arms connected by a curve 1,800 feet in length, of 1,910 feet radius. The westerly arm is to be 3,000 feet long, pointing S. 72° E. (magnetic); the easterly arm, as extended, 4,200 feet long, pointing N. 54° E. (magnetic). A gap of about 1,850 feet is to be left between the east shore of Point Fermin and the westerly end of the breakwater.

Originally San Pedro Bay was an open roadstead exposed to southeasterly, southerly, and southwesterly winds. The effect of the breakwater will be to afford a place of refuge, easy of access and secure from storms, for vessels of the largest size. It will also shelter the entrance to the inner harbor of San Pedro.

On August 12, 1898, a continuing contract was entered into with Heldmaier & Neu, of Chicago, Ill., for the construction of the breakwater for \$1,303,198.54. This contract was annulled on March 19, 1900, on account of unsatisfactory progress. Under this contract 86,610 tons of stone was placed in the foundation course, at a cost, including inspection, of \$51,537.43.

On June 7, 1900, a continuing contract for completing the breakwater was entered into with the California Construction Company, of San Francisco, Cal. The estimated cost of work under this contract, using the quantities on which bids were canvassed and the prices bid for stone and concrete, and allowing 10 per cent for engineering expenses and contingencies, is \$2,613,100.66, in addition to expenditures under the former contract. This estimate is for a

breakwater 8,500 feet long. The extension of the breakwater to 9,000 feet in length is estimated to cost about \$206,250 additional.

The amount expended under the project up to the close of the fiscal year ending June 30, 1907, is \$2,294,211.18, including the expenditures of the Board referred to above.

Work was begun on the westerly end of the substructure. Up to June 30, 1907, 1,969,780 long tons of stone, at \$0.844 per ton, had been deposited in the substructure under the present contract, and the substructure was about completed for a distance of 8,452 feet.

The superstructure was begun at a distance of 628 feet from the westerly end and is being built to the eastward. To June 30, 1907, 169,394 long tons of stone had been placed in the superstructure, at \$3.10 per ton, and this, while partially completing it over a length of 7,238 feet, is equivalent to 6,606 feet of completed work. The project is about 84 per cent completed.

The protected area is used by vessels which have to lighter a part of their cargo or have to await a favorable tide before they can enter the inner harbor. The effect of continuing work under the existing project will be to enlarge the protected area and to increase the shelter afforded the entrance to the inner harbor.

The available balance and the \$100,000 authorized but not yet appropriated will be expended in extending the breakwater under contract.

There are as yet no commercial wharves in the outer, or breakwater, harbor. The construction of bulkheads, etc., has been begun, and it is expected that facilities for commerce will be greatly developed during the year. For commercial statistics see report on Wilmington Harbor.

For reference to report on examinations and surveys see Annual Report of the Chief of Engineers for the year 1904, page 634.

July 1, 1906, balance unexpended.....	\$599,932.20
Amount appropriated by sundry civil act approved March 4, 1907....	92,915.00
	<hr/> 692,847.20
June 30, 1907, amount expended during fiscal year, for works of improvement.....	187,058.33
July 1, 1907, balance unexpended.....	505,788.87
July 1, 1907, outstanding liabilities.....	31,437.09
	<hr/> 474,351.78
July 1, 1907, amount covered by uncompleted contracts.....	415,714.12
Amount (estimated) required for completion of existing project....	100,000.00
	<hr/>
{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907.....	
{ Submitted in compliance with requirements of sundry civil act of June 4, 1907.....	
	100,000.00

(See Appendix T T 2.)

3. *Wilmington Harbor, California.*—Wilmington is situated at the head of a small estuary which has its outlet in the Bay of San Pedro, and is 393 nautical miles to the southward of San Francisco.

Previous to the commencement of the improvement, in 1871, there was a depth of less than 2 feet of water at low tide at the entrance.

The original project, approved July 1, 1871, contemplated gaining a depth of 10 feet at mean low tide. This depth was obtained in



1881, at a cost of \$555,000, when a further project to increase depth of channel to 15 feet at mean low tide by dredging a reef between the jetties, raising existing works, and extending the jetties to 18 feet of water in San Pedro Bay, was submitted. This project was completed in 1893, at a cost of \$399,497.68.

The river and harbor act of June 3, 1896, appropriated \$50,000 for improving the harbor in accordance with a project submitted in 1894 for a channel depth of 18 feet at mean low tide, at an estimated cost of \$392,725. Owing to certain provisos, however, this money was not available without further action by Congress.

The present project was adopted by the river and harbor act of June 13, 1902, and contemplates providing a channel 20 feet deep and 400 feet wide from the outer harbor to the foot of the wharves; and 24 feet deep between harbor lines from the foot of the wharves to and including a turning basin 1,600 feet in diameter just below Mormon Island. It also provides for repairs to the east jetty and for the construction of a dike to divert the waters of the Los Angeles River from Wilmington Lagoon. The same act made available the \$50,000 appropriated by the act of June 3, 1896.

Changed conditions have rendered the building of the dike inadvisable.

The original estimated cost of the work called for by the present project, including the procurement of a dredge, is \$550,000. This estimate has been increased to \$663,000.

The river and harbor act of March 2, 1907, and the sundry civil act of March 4, 1907, appropriated \$113,000 and \$50,000, respectively, for this work, completing the full amount of the estimated cost.

The amount expended under the existing project to June 30, 1907, is \$477,631.69, and the project is about 52 per cent completed.

Repairs have been made to the east jetty at a cost of \$3,700.

A 20-inch suction dredge, with the necessary discharge pipe line, floating plant, etc., has been built at a total cost of \$118,721.78. The work of dredging the harbor began April 1, 1905, since which time 1,774,044 cubic yards of material has been dredged and deposited behind bulkhead lines on Terminal Island, or outside the jetties, at a cost of \$144,425.69, or about \$0.08 per cubic yard. At the entrance to the harbor 355,785 cubic yards has been dredged under contract at a cost of \$168,579.90 (contract payments only), and between the entrance and the upper end of the wharves 249,340 cubic yards has been dredged under contract at a cost of \$39,894.40.

The entrance channel has been dredged to a width of 400 feet and a depth of 21 feet. A channel 400 feet wide, with a least depth of 20 feet, has been dredged from the entrance to the lower end of the wharves, and dredging to a depth of 25 feet has been done between the wharves as far north as Smiths Island, a distance of about 5,000 feet. This depth of 25 feet, with a width of 200 feet, has also been carried along the easterly side a further distance of 817 feet. Northward of there dredging to the depth of 20 feet has also been done in front of all wharves on both sides of the harbor.

The minimum draft that could be carried over the bar on June 30, 1907, was 20 feet at mean lower low water. The average rise of the tide above this plane of reference is 5.1 feet.

The available balance will be expended in dredging with Government dredge and for contingencies.



For the calendar year 1906 the commerce of this port amounted to 1,007,476 tons, a decrease of 7 per cent from the preceding year. It consists principally of lumber, crude oil, and general merchandise received, and of general merchandise and crude oil shipped. Its value is estimated at \$20,245,000.

It is difficult to estimate accurately the effect of this improvement on freight rates. The principal traffic of the harbor is in lumber received from northern California, Oregon, and Washington, and shipped inland by rail, and amounts for the calendar year 1906 to nearly 1,000,000 tons. The water rate on lumber from Puget Sound points to Los Angeles is about \$5 per ton; the railroad rate, \$12.50 per ton. Without the improvement of Wilmington Harbor, lumber would have to be unloaded at exposed piers or brought to San Pedro in vessels of light draft or lightered ashore. The saving in freight, lighterage charges, and insurance is large, but can not be definitely stated.

For reference to reports on examinations and surveys, see Annual Report of the Chief of Engineers for the year 1904, page 635.

July 1, 1906, balance unexpended.....	\$140, 710. 82
Amount appropriated by sundry civil act approved March 4, 1907.....	50, 000. 00
Amount appropriated by river and harbor act approved March 2, 1907.....	113, 000. 00
Receipts from sales, damages to dredge, etc.....	88. 75
	<hr/> 303, 799. 57
June 30, 1907, amount expended during fiscal year, for works of improvement.....	117, 831. 69
July 1, 1907, balance unexpended.....	185, 967. 88
July 1, 1907, outstanding liabilities.....	6, 061. 22
July 1, 1907, balance available.....	<hr/> 179, 906. 66

(See Appendix T T 3.)

4. *San Luis Obispo Harbor, California.*—San Luis Obispo Harbor is 9 miles to the southward and westward of the town of San Luis Obispo and 216 nautical miles from San Francisco.

It is a bight of the coast about 18 miles long between Point San Luis on the north and Point Sal on the south. The upper end, where Port Harford is situated, has a wharf and is the part used for commercial purposes. Whaler reef, extending nearly half a mile to the southward and eastward of Point San Luis, forms more or less of a natural breakwater, but during the winter season the landing was exposed to the heavy swell caused by southerly gales.

The original project was adopted by the river and harbor act of August 11, 1888, and provided for the construction on Whaler reef of a breakwater of rubblestone rising to mean lower low water and extending from Point San Luis to Whaler Island and thence to a point where the outer reef rises above high water. Exclusive of Whaler Island, which is 245 feet long, the breakwater was to have a length of about 1,736 feet, and its estimated cost was \$284,898.

This project was modified January 17, 1893, to provide for raising the structure to the height of 6 feet above mean high water, with a top width of 20 feet and such side slopes as might be formed under the action of the sea. The estimated cost was increased to \$568,660. This is the existing project.

The amount expended on this work up to June 30, 1907, is \$305,001.78, and the project is 53 per cent completed.

The breakwater has been built to full section from Point San Luis to Whaler Island and for 765 feet beyond Whaler Island, and has been partly built up for 595 feet farther, or a total distance of 1,941 feet, including the island. The partially protected area has an available depth of 20 to 33 feet at mean lower low water and there is 30 feet depth at the Port Harford wharf, which was extended during the year. The mean rise of tide is 4.6 feet. The result has been to give increased security to vessels in the anchorage and at the landing.

The river and harbor act of March 2, 1907, appropriated \$63,660 and authorized continuing contracts for the completion of the work at a cost not to exceed \$200,000 yet to be appropriated.

Proposals for completing the breakwater have been received and a continuing contract will be entered into at an early date with the San Francisco Bridge Company for the delivery of 151,140 tons of stone at \$1.57 per ton, which amount will complete the project.

Further work under the project will afford increased shelter, and the \$200,000 yet to be appropriated should be applied to the extension of the breakwater to its full projected length and height.

The commerce consists principally of lumber and general merchandise received and grain and crude oil shipped. Its volume for 1906 is 580,564 tons, an increase of 30 per cent over that of the previous year. This great increase is due to the large shipment of crude oil. The value of this commerce is estimated at \$4,730,000.

It is impracticable to give definite figures relative to the influence of the project on freight rates. The following, however, may throw some light on the matter. The Union Oil Company pumps crude oil through a 6-inch pipe from its wells in the northern part of Santa Barbara County, a distance of 40 to 45 miles, to the landing at Port Harford, and thence ships it in tank vessels to the Hawaiian Islands and coast points. The Standard Oil Company also ships oil from this port. The cost of delivery of oil in San Francisco is about 10 cents per barrel, and the oil is sold there for from \$1 to \$1.25 per barrel. The railway rate to San Francisco is about 60 cents per barrel.

Reference to reports on examinations and surveys will be found in Annual Report of the Chief of Engineers for the year 1904, page 636.

July 1, 1906, balance unexpended.....	\$241. 59
Amount appropriated by river and harbor act approved March 2, 1907.....	63, 660. 00
	<hr/>
	63, 901. 59
June 30, 1907, amount expended during fiscal year, for works of improvement.....	242. 42
	<hr/>
July 1, 1907, balance unexpended.....	63, 659. 17
July 1, 1907, outstanding liabilities.....	30. 40
	<hr/>
July 1, 1907, balance available.....	63, 628. 77
	<hr/>
Amount (estimated) required for completion of existing project.....	200, 000. 00
	<hr/>
{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907.....	100, 000. 00
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

(See Appendix T T 4.)

IMPROVEMENT OF CERTAIN RIVERS AND HARBORS IN CALIFORNIA,  
TRIBUTARY TO AND NORTH OF SAN FRANCISCO BAY.

This district was in the charge of Col. W. H. Heuer, Corps of Engineers, to February 21, 1907; of Maj. Wm. W. Harts, Corps of Engineers, from February 21 to May 31, 1907, and of Lieut. Col. John Biddle, Corps of Engineers, since May 31, 1907.

1. *Oakland Harbor, California.*—The original conditions of San Antonio estuary were as follows: It was simply a tidal arm of the Bay of San Francisco, with a tidal prism of 156,000,000 cubic feet. This filled and emptied itself with each coming tide. The tidal flow was sufficient to maintain a natural channel depth over the bar, off the mouth, of 2 feet at low tide. Within the estuary proper, where the bends are pronounced, mid-channel depths of 20 to 23 feet at low water and widths of 500 feet were found. The original project for making a harbor at Oakland was submitted in 1874 in compliance with an act of Congress. The report, with project and estimate of cost, is printed in the Annual Report of the Chief of Engineers for 1874, page 378.

Before improvement vessels drawing 5 to 8 feet could enter San Antonio estuary at high tide. The commerce in 1874 aggregated 154,300 tons, in 1894 it had increased to 2,428,617 tons, and in 1905 it amounted to 5,248,307 tons, and vessels drawing 23 feet of water could enter at high tide.

The original project called for (a) two mid-tide training walls at the entrance, (b) a tidal canal for flushing purposes about  $1\frac{1}{2}$  miles in length to connect with tide water in San Leandro Bay, (c) a dam at the entrance to San Leandro Bay, and (d) dredging a tidal basin and then a channel to have a depth of 20 feet from the basin to San Francisco Bay. The original estimated cost of the work was in round numbers \$1,815,000.

This was approved by Congress, and during the progress of the work slight modifications were made from time to time. These consisted of raising the training walls to full high-tide level; of increasing the width of the tidal canal to 400 feet; of building three steel bridges across the tidal canal; and of diverting the silt-laden storm waters of Sausal Creek from the tidal canal by means of a separate channel into San Leandro Bay. This project, with the exception of the dam across the entrance to San Leandro Bay, which may not be necessary, and a slight extension of the south jetty farther into San Francisco Bay, is now practically completed, and up to June 30, 1907, has cost \$2,814,752.62.

In the river and harbor act of 1900 Congress provided for an examination of Oakland Harbor with a view to its improvement west of the tidal canal to meet the needs of present and prospective commerce. Three alternative plans and estimates for channel enlargement were submitted, estimated to cost, respectively, \$646,293, \$1,687,818, and \$968,203. This report, with estimates, is printed in the Annual Report of the Chief of Engineers for 1901, pages 3448-3449.

On June 13, 1902, Congress appropriated \$100,000 and authorized continuing contracts for \$150,000 additional for the work, but failed to specify to which of the above projects the funds were to be applied. Contract was made to the extent of the money available and author-

ized for dredging work which was common to all of the above projects. By act of March 3, 1905, Congress specifically named project No. 3, estimated to cost \$968,203, appropriated \$100,000, and authorized contracts for \$250,000 additional for continuing the improvement with a view to obtaining a channel 300 feet wide and 25 feet deep from San Francisco Bay to Fallon street, Oakland.

Project No. 3 calls for a channel from San Francisco Bay, 500 feet wide and 25 feet deep at low water, to Chestnut street, Oakland; thence 300 feet wide and 25 feet deep at low water to Fallon street; thence 300 feet wide and 17 feet deep to tidal basin; thence 300 feet wide and 12 feet deep around the tidal basin, and extension of south jetty.

In the act of March 2, 1907, Congress provided for the project No. 3, as recommended by the Board of Engineers for Rivers and Harbors in report of January 11, 1907, printed in River and Harbor Committee Document No. 9, Fifty-ninth Congress, second session, but the act extended the provisions of the project as follows:

Extension of south jetty 500 feet, widening to 500 feet the channel 25 feet deep from San Francisco Bay to Fallon street, deepening to 25 feet the channel 300 feet wide from Fallon street to the tidal basin, deepening to 17 feet the channel 300 feet wide around the north side of the tidal basin to the tidal canal, and from the tidal canal along the Alameda shore to Tenth avenue.

No estimate of cost has been made for this final project authorized by Congress. A rough estimate is an additional cost of about \$500,000 over the estimate of project No. 3, making a total cost of about \$1,468,203. It is proposed to defer the construction of the extension of the south jetty until the necessity for such an extension should be more apparent.

This work is in progress under the continuing-contract system. The balance of the contract authorization of 1907 remaining to be appropriated is \$300,000; of that of 1905, \$146,000. It is proposed to expend available funds for dredging in accordance with the project.

On June 30, 1907, at low-tide level, a channel 300 feet wide and 25 feet deep has been made for a length of 16,500 feet easterly from deep water in San Francisco Bay; also a channel 400 feet wide and 20 feet deep from said bay to Chestnut street, 300 feet wide and 17 feet deep to the tidal basin, 300 feet wide and 12 feet deep on the south side of the tidal basin, and 300 feet wide and 8 feet deep on the north side of the tidal basin. The above depths could be carried at low water on June 30, 1907. The tidal range is from 4.5 feet to 5.5 feet.

The work on project No. 3 is about two-thirds completed. The whole project as authorized by Congress in act of March 2, 1907, would be about one-third completed. The navigable portion of the channel is about 30,000 feet in length. Shallow-draft low vessels can go a mile farther.

The money thus far spent has been practically all for extensions in channel widths and depths for the benefit of commerce. Very little has been spent for maintenance.

It is difficult to estimate what increase of commerce is likely to result from an increased depth and width of channel in Oakland Harbor. At present about 72 per cent of the total tonnage of Oakland Harbor is overland railroad freight transferred across the bay

on ferryboats, which when loaded with cars draw only about 8 feet of water. If improvement be continued it will permit of deeper-draft vessels carrying to the city of Oakland coal, wood, coke, oil, hay, grain, flour, lumber, building material, and sundries, which in 1906 amounted to 1,541,182 tons, and also should induce a large increase in manufacturing industries on the shores of this harbor.

It is believed that the improvement has had no effect on freight rates.

The work is being carried on by contract at a cost of 10.5 cents per cubic yard, place measurement. During the year 674,977 cubic yards of material has been dredged and placed ashore. It is expected that the existing contract will be completed about March 1, 1908:

July 1, 1906, balance unexpended.....	\$135,993.44
Amount appropriated by river and harbor act of March 2, 1907.....	68,203.00
Amount appropriated by sundry civil act approved March 4, 1907....	23,000.00
	<hr/>
	227,196.44
June 30, 1907, amount expended during fiscal year, for works of improvement .....	69,146.06
	<hr/>
July 1, 1907, balance unexpended.....	158,050.38
July 1, 1907, outstanding liabilities.....	4,461.61
	<hr/>
July 1, 1907, balance available.....	153,588.77
	<hr/>
July 1, 1907, amount covered by uncompleted contracts.....	85,385.77
Amount (estimated) required for completion of existing project....	946,000.00
	<hr/>
{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907.....	
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897.	
	250,000.00

(See Appendix U U 1.)

2. *San Pablo Bay, California.*—Before work was commenced there was a shoal about 27,000 feet long, with a least depth of 19 feet at low water, with a gradual increase of depth toward each end of the shoal, where the depth was 30 feet. These depths extended from 1,000 to 1,500 feet in width, and outside of these widths there is a gradual shoaling to each side of the bay. Ships going to and from Port Costa grain warehouses, from which most of the grain raised in California is shipped, and ships going to and from Mare Island Navy-Yard, all passed over this shoal. In many cases it was necessary to choose the time of high water to pass over the shoal with ships not fully laden. All the commerce passing into and from the Sacramento and San Joaquin rivers passes over this shoal.

Report on examination, with estimate, is printed in the Annual Report of the Chief of Engineers for 1900, page 4260. The project contemplates a channel 300 feet bottom width, 30 feet depth at low water, and 27,000 feet long; estimated to cost \$381,000, and about \$16,000 per year thereafter for maintenance. Congress adopted this project on June 13, 1902, by appropriating \$100,000 and authorizing continuing contracts for \$281,000 additional. No project was adopted or improvement made prior to the present project.

This work was completed February 6, 1906. A survey made in April and May of this year shows that the channel has shoaled over four-fifths of its length, this shoaling extending for one-half a mile,

so as to give a depth of only 24 feet, and amounting to 1,000,000 cubic yards.

The maximum available depth for navigation at low tide is 24 feet. The ordinary range of tide is from 3.5 feet to 5.5 feet.

The amount expended on this project to June 30, 1907, is \$331,498.25.

This improvement was needed to permit naval vessels to reach Mare Island Navy-Yard at all stages of the tide. It is not required by the present commerce, and has had no effect on freight rates.

The funds on hand will be used for dredging to preserve navigable depths.

July 1, 1906, balance unexpended.....	\$53, 569. 76
June 30, 1907, amount expended during fiscal year, for works of improvement .....	31, 899. 60

July 1, 1907, balance unexpended.....	21, 670. 16
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(See Appendix U U 2.)

3. *San Joaquin River, California.*—Before improvement the channel below Stockton was 6 feet in depth, crooked, and difficult to navigate. The upper river, above Stockton, was navigable only at high water, which lasted but a few months each year, and carried but little commerce.

Project for improvement, which was made in 1877 and slightly modified in 1881-82, was to secure and maintain by dredging and by cut-offs a channel 9 feet deep and 100 feet wide to Stockton, and one 4 feet deep and 80 feet wide in Mormon Channel up to Miller's warehouse, as well as temporary improvement of the upper river by snagging, scraping, removal of bars, and the partial closing by weirs of Lairds Slough and Paradise Cut. Eight cut-offs below Stockton have been made by the Government and several by the State of California. The depths have been fairly well maintained in the river proper, but it has been impracticable in the past few years, in consequence of the enormous lodgment of débris brought down through Mormon Channel, to continually maintain these depths in Stockton Channel, which is about 1½ miles in length and on which the city of Stockton is situated.

The existing project is essentially the project of 1877, extended to cover the construction and keeping in repair of the weirs across Paradise Cut and Lairds Slough.

The total amount expended on the project up to June 30, 1907, was \$520,459.48.

As in the previous year, a heavy rainfall during the winter of 1906-7 resulted in heavy freshets, which caused an immense amount of detritus to be brought down Mormon Channel and deposited in Stockton Channel in such quantities that in December, 1906, navigation into the town of Stockton was stopped, the regular daily boats plying between Stockton and San Francisco having to discharge their cargoes just inside Stockton Channel, a little over a mile from the wharves. Emergency contract was made on December 28, 1906, with the San Francisco Bridge Company to dredge a channel in Stockton Channel, and work was commenced in January, 1907. Much delay was caused by continued freshets, which not only impeded the work, but brought down fresh detritus which continually refilled the dredged channel. Work was continued and, on June 30, 1907, is

still in progress. A total of 203,621 cubic yards of material has been dredged and deposited under this contract. The quantity still to be dredged is from 60,000 to 80,000 cubic yards.

The maximum depth that could be carried to Stockton at mean low tide on June 30, 1907, was 6 feet. The river is at about a 6-foot stage in the San Joaquin, so that until dredged the bar would be practically bare in Stockton Channel at low water. The tidal range is about 2 feet; the freshet range about 8 feet. The distance from Stockton to the mouth of the San Joaquin River is 50 miles. About 2 to 3 feet can be carried at low water up the San Joaquin River about 20 miles. At high water boats go occasionally to Firebaugh, 300 river miles above Stockton.

The commerce of the San Joaquin River is reported by Mr. J. M. Eddy, secretary of the Stockton Chamber of Commerce, who took great pains to compile the statistics, as reaching 971,382 tons during the year 1906, valued at \$14,770,730, exclusive of the freight carried by the steam and gasoline launches plying between Stockton and the many river islands which are under cultivation, and which carry large amounts of supplies and produce, but of which no accurate account can be obtained. Nearly all this freight is carried on the lower San Joaquin River below Stockton, the commerce of the upper San Joaquin being small. The California Navigation and Improvement Company estimates the value of the commerce at 212 tons, valued at \$12,720.

July 1, 1906, balance unexpended.....	\$18,774. 29
Amount appropriated by river and harbor act approved March 2, 1907.....	30,000. 00
	<hr/>
	48,774. 29
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	14,563. 77
	<hr/>
July 1, 1907, balance unexpended.....	34,210. 52
July 1, 1907, outstanding liabilities.....	3,735. 54
	<hr/>
July 1, 1907, balance available.....	30,474. 98
	<hr/>
July 1, 1907, amount covered by uncompleted contracts.....	5,000. 00
(See Appendix U U 3.)	

4. *Stockton and Mormon channels, California.*—The act of June 13, 1902, provided for the diversion of the waters of Mormon Channel into the Calaveras River. The project is printed in the Annual Report of the Chief of Engineers for 1899, page 3189. Its estimated cost is \$255,016. Congress has now appropriated \$224,316 for the work. By act of March 2, 1907, Congress authorized contracts not exceeding \$56,079, yet to be appropriated, for completing the project.

The act of 1902 requires that the city of Stockton or the State of California shall first furnish to the United States the right of way for the canal. The title to the right of way has been acquired by the State of California and steps are being taken to transfer it to the United States.

No work by the General Government has yet been done, and can not be done until the right of way is transferred.



July 1, 1906, balance unexpended.....	\$224, 316. 00
July 1, 1907, balance unexpended.....	224, 316. 00
Amount (estimated) required for completion of existing project...	56, 079. 00

{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907.....	56, 079. 00
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

(See Appendix U U 4.)

5. *Mokelumne River, California.*—This river, a tributary of the San Joaquin River, is a tidal stream, navigable in the main stream, including its south branch or fork, for about 34 miles. The head of navigation is now at the Galt-New Hope bridge, 20 miles above the mouth of the river. Six feet depth at low tide can be carried to the mouth of Snodgrass Slough, about 13 miles above the mouth of the river; then a shoal is found, less than half a mile in length, with a depth of 2 feet over it to New Hope Landing, which for many years past has been the upper terminus of a line of steamboats plying from San Francisco. The tidal range is about 3 feet.

Before improvement navigation was difficult on account of snags and overhanging trees. Project for their removal was made in 1881, estimated to cost \$8,250. This project was enlarged in 1891 to include the closing of a small slough or canal and removing by dredging a tongue of land opposite New Hope Landing and continuing the work of snagging. Since that time work has been done at irregular intervals.

The bar opposite New Hope Landing interferes with navigation.

No work was done during the fiscal year ending June 30, 1907.

The total amount expended on this improvement to June 30, 1907, was \$19,302.88. The balance now available will be applied toward removing any snags which may obstruct navigation.

The improvement has resulted in a reduction of freight rates. There have been no records kept of the tonnage on this river. It is estimated by various parties as between 50,000 and 100,000 tons. This is largely carried by scow-schooners on irregular trips. The steamboat company operating on the river gives the amount of tonnage carried by its steamers as 25,000 tons, at an estimated value of \$1,500,000. The imports are lumber, coal, live stock, and merchandise; the exports, grain, fruit, vegetables, and other produce.

July 1, 1906, balance unexpended.....	\$1, 197. 12
Amount appropriated by river and harbor act approved March 2, 1907.	2, 500. 00

July 1, 1907, balance unexpended.....	3, 697. 12
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(See Appendix U U 5.)

6. *Petaluma Creek and Napa River, California.*—(a) *Petaluma Creek.*—This creek has a length of 16 miles and is an estuary of San Pablo Bay. Its head of navigation is the town of Petaluma, a place of about 4,000 inhabitants.

Before improvement it was very crooked, dry in many places at low tide, and could be navigated only at medium or high-tide stages. The extreme tidal range is a little less than 9 feet.

Project was made in 1880 for straightening the creek by making cut-offs and dredging so as to obtain a channel 50 feet wide and 3 feet deep at low water, estimated to cost \$25,868. In 1892 the



project was extended to dredge the channel as deep as funds would permit. Work has been done under the project as funds were appropriated. The project was enlarged by the river and harbor act of March 2, 1907, to provide for dredging a channel 6 feet deep at low tide and 50 feet bottom width from the mouth of the creek to McNears Canal, and 4 feet deep and 50 feet wide thence to the head of navigation at Petaluma. The additional cost of this work is estimated at \$15,239.

The last dredging in the creek was done in 1904, and on its completion a good channel 50 feet wide and 4 feet deep at low water had been procured.

No work has been done during the fiscal year, but shoaling in the channel having been reported a survey was made of the creek to determine the extent of the work necessary to carry out the approved project. Specifications are being prepared to advertise the work, which it is proposed to do early in the coming year. This survey showed one bar practically dry at extreme low water, with 2 feet over remaining bars up to McNears Canal, 1,500 feet below the town of Petaluma. The head of navigation is 6,000 feet farther up. The average tide is about 8 feet, and navigation is carried on during high stages.

The total amount expended to June 30, 1907, is \$67,811.02. The available amount will be used for dredging. Navigation is very important to the community and has probably had effect in keeping down rates, though it can not be definitely stated that there has been any reduction in freight rates due to the project. It has, however, encouraged the establishment of factories in the town of Petaluma.

During the year 1906 the commerce was carried by two stern-wheel steamers, the *Gold*, of 293 tons, and the *Sonoma*, of 260 tons, both of which made 313 round trips in the year, and by scow-schooners, which carried the heavier freight. It is reported that 175,025 tons of freight, valued at \$2,958,340, was carried on the creek during the year 1906, as well as 19,262 passengers.

The enlarged project is printed in House Document No. 387, Fifty-ninth Congress, first session.

July 1, 1906, balance unexpended.....	\$2, 231. 23
Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	15, 239. 00
	<hr/> 17, 470. 23
June 30, 1907, amount expended during fiscal year, for works of improvement.....	42. 25
	<hr/> 17, 427. 98
July 1, 1907, balance unexpended.....	17, 427. 98
July 1, 1907, outstanding liabilities.....	250. 00
	<hr/> 17, 177. 98

Amount (estimated) required for completion of existing project. Indeterminate.

(b) *Napa River*.—Before improvement this river had a low-water depth of 5 feet for about 12 miles above the Mare Island Navy-Yard and about 1 foot depth on the crest of the bars in the next 4 miles of its length to the head of navigation in front of the town of Napa. The ordinary range of tides is about 5 feet. Spring tides reach a height of 7 feet.

Project for the improvement was made in 1888, which contemplated the dredging of the bars and cutting off projecting points of land so as to obtain a channel 75 feet wide with a least depth of 4 feet at low tide and to remove logs, snags, and other obstructions. The estimated cost was \$27,600. Examinations were again ordered by Congress and made in 1896, 1899, and 1902. Report on the latter is printed in the Annual Report of the Chief of Engineers for 1904, page 3427.

Navigation on the river is possible and profitable only at medium and high stages of the tide. The existing project and old project are identical.

Work was begun in accordance with the project in 1889 and has progressed since whenever funds became available. The amount expended on this improvement to June 30, 1907, is \$32,750.61.

No work was done during the fiscal year ending June 30, 1907. Congress having appropriated funds for improving this river, survey was made in June, 1907, and work will be done as soon as practicable. This survey showed 2 to 4 feet generally at low tide, except at two shoal places on the river.

The funds available will be applied as may be necessary to the removal of bars which continually form and obstruct navigation.

Freight rates are reasonable, due to the maintenance of navigation.

The commerce on Napa River during the year 1906 was carried on three regular steamers and several scow-schooners which make irregular trips on the river. The freight carried on this river during the year is reported at 182,642 tons, the value not being given.

July 1, 1906, balance unexpended.....	\$1,234.20
Amount allotted from appropriation by river and harbor act approved March 2, 1907.....	8,000.00
	<u>9,234.20</u>
June 30, 1907, amount expended during fiscal year, for works of improvement .....	55.45
July 1, 1907, balance unexpended.....	9,178.75
July 1, 1907, outstanding liabilities.....	62.50
July 1, 1907, balance available.....	<u>9,116.25</u>
Amount (estimated) required for completion of existing project..	Indeterminate.

## CONSOLIDATED.

July 1, 1906, balance unexpended.....	\$3,465.43
Amount appropriated by river and harbor act approved March 2, 1907 .....	23,239.00
	<u>26,704.43</u>
June 30, 1907, amount expended during fiscal year, for works of improvement .....	97.70
July 1, 1907, balance unexpended.....	26,606.73
July 1, 1907, outstanding liabilities.....	312.50
July 1, 1907, balance available.....	<u>26,294.23</u>
Amount (estimated) required for completion of existing project..	Indeterminate.
(See Appendix U U 6.)	

7. *Humboldt Harbor and Bay, California.*—A description and history of the work done at this locality is printed in the Annual Report of the Chief of Engineers for 1900, page 4237.

Before improvement the entrance to the harbor was obstructed by a bar having channel depths of 12 to 15 feet. This channel was not fixed in direction, and sometimes for weeks at a time vessels were bar bound. Inside the harbor, in front of the towns of Eureka, Arcata, and Hookton, the channels were very shoal.

In 1881 project for deepening the channels in front of these towns by dredging was adopted. The work was done by contract, was completed in 1884 at a cost of \$80,884.69, and resulted in channels 200 feet wide and 12 feet deep in front of Eureka and 100 feet wide and 10 feet deep in front of Arcata and Hookton.

In 1882 project for improving the entrance to the harbor was adopted. It called for a low jetty, estimated to cost \$600,000, which was to be about 6,000 feet in length, to extend from the south spit seaward. This was somewhat modified in 1888 and again in 1891, so as to build nearly parallel high jetties, each about 8,000 feet in length, to extend seaward to the crest of the bar. The estimated cost of the work was \$2,057,615. Congress adopted this project in 1892 and authorized work under the continuing-contract system.

The work on the jetties was commenced in 1889 and was completed in August, 1899, at a cost of \$2,040,203.35. It resulted in a fine channel, having a least depth of 28 feet at low water. A resurvey, made in August, 1903, showed a channel through the entrance having a least low-water depth of 31 feet. Since that time the channel has in places deteriorated. A bar has formed outside the entrance whose longer axis is nearly at right angles to the former jetty channel. The result is that vessels instead of going straight to sea, as formerly, now make a sharp turn to the right, broadside to the sea, immediately on passing the outer end of the north jetty. The depth of water in the channel between the bar and the north jetty is sufficient, but on account of its direction it is dangerous for vessels passing in and out during rough weather.

A resurvey of the bar was made in July and August, 1905, which showed channel depths of 23 feet straight out to sea, 19-foot depths in south channel, and 26-foot depths in north channel.

In March, 1899, project was adopted for dredging a channel 15 feet deep, 200 feet wide, and 8,900 feet long in front of Eureka, estimated to cost \$50,000. Work was done by contract, and a channel of the dimensions contemplated was completed in March, 1901, and has since been well maintained.

By act of March 2, 1907, Congress adopted a project for further improvement in accordance with report printed in House Document No. 228, Fifty-ninth Congress, first session, which contemplates enlargement of the channel in front of Eureka to a depth of 18 feet and width of 300 feet for a length of 6,200 feet, at an estimated cost of \$83,000.

The amount expended on this work to June 30, 1907, is \$2,178,297.05.

On June 30, 1907, the least depth of water at the entrance to the harbor is about 22 feet at extreme low water. At the wharves at Eureka it is about 13 feet. The tidal range is about 5.5 feet.

Since the improvement and within the past five years the population of Eureka has increased from 7,000 to about 13,000 persons. The

commerce has increased. Deeper-draft vessels and more of them now run regularly to Humboldt Bay.

The following table shows the increase in the annual commerce since 1885:

	Passen- gers.	Freight.		Passen- gers.	Freight.
		<i>Tons.</i>			<i>Tons.</i>
1885.....	4,195	162,614	1905 .....	32,748	616,753
1895.....	11,514	236,378	1906 .....	35,423	706,549

The tonnage in 1906, valued at \$15,385,367, was carried on 1,803 steam and 203 sailing vessels.

July 1, 1906, balance unexpended.....	\$9,542.70
Amount appropriated by river and harbor act approved March 2, 1907.....	83,000.00
	<hr/> 92,542.70

June 30, 1907, amount expended during fiscal year, for works of improvement .....	224.75
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July 1, 1907, balance unexpended.....	92,317.95
July 1, 1907, outstanding liabilities.....	20.00

July 1, 1907, balance available.....	92,297.95
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(See Appendix U U 7.)

8. *Removing sunken vessels or craft obstructing or endangering navigation.*—During the month of June, 1907, the wreck of the scow-schooner *Witch of the Bay* was removed from Mare Island Straits, California, at a cost of \$34.68.

(See Appendix U U 8.)

#### IMPROVEMENT OF SACRAMENTO AND FEATHER RIVERS, CALIFORNIA.

The improvement of these rivers is in the charge of a Board of three engineer officers appointed in accordance with the provisions of an act of Congress of June 3, 1896, Capt. Thos. H. Jackson, Corps of Engineers, having immediate charge of the work.

In the earliest days of California, before the advent of railroads, handsome, fast, and commodious steamboats, drawing from 6 to 7 feet, ran regularly between San Francisco and Sacramento. All travel was necessarily by boats, which were crowded with passengers and freight at rates very greatly in excess of present prices. The depth of water at that time in the shoalest places below Sacramento was about 7 feet at low water and low tide. Thereafter, largely in consequence of hydraulic mining, shoaling resulted, until on the worst bars at certain low-water periods only 4 feet channel depth could be carried to Sacramento. In 1875 appropriations began to be made by Congress for improving the river and have continued at irregular intervals since. The object sought was to improve the depths over the bars, generally by the construction of wing dams, scraping, closing of crevasses or breaks in the levees, and principally to aid navigation by the removal of snags.

In work of this character a total of \$878,749.46, of which \$807,391.54 was from the appropriation for "Improving Sacramento

and Feather rivers, California," and \$71,357.92 from the appropriation for "Improving Sacramento River, California," has been spent up to June 30, 1907. The work has resulted in obtaining at the present time a least low-water channel depth of 7 feet to Sacramento, 4 to 5 feet depths to Colusa, and 24 to 30 inches depth to Red Bluff. The present depths accommodate all commerce existing and that in sight for several years to come. There have been no boats reported aground in the lower Sacramento River below Sacramento for several years; in the upper river when boats were aground it was due to overloading, getting out of the channel, or getting snagged.

The head of navigation is at Red Bluff, which is by river 262 miles above the mouth of the river. The extreme range of the river at Red Bluff is 22+ feet; at Collinsville, its mouth, the range is 8+ feet.

The commerce of the Sacramento River is variable and depends principally upon the crops. Up-river freight is generally merchandise, groceries, and farming implements; down-river freight consists of wheat, barley, fruit, vegetables, cordwood, and brick.

The total tonnage carried on the Sacramento River in 1906 is reported as 375,000 tons. The average yearly tonnage for the past twelve years has been about 430,000. The maximum tonnage reported carried was in 1892, which amounted to 579,574 tons.

The freight on the Feather River is carried on a small gasoline steamboat and a gasoline launch, and is estimated at 5,000 tons per annum.

The work done during the fiscal year has been the clearing of the Sacramento River of snags by means of the U. S. snag boat *Seizer* and the construction of several wing dams.

The amount expended during the fiscal year has resulted in keeping the river in good navigable condition.

The balance available for these rivers on June 30, 1907, will be applied toward operating the snag boat for the removal of snags, and for concentrating the currents by means of wing dams, for removing bars and increasing depths.

A permanent annual appropriation of \$25,000, as recommended by all previous Boards which have reported on this river, is again urged. The improvements made have maintained a navigable river, and have therefore had a beneficial effect in regulating and maintaining a reasonable freight rate.

More extended information concerning the Sacramento River and its tributaries, with map, may be found in House Document No. 262, Fifty-ninth Congress, first session.

#### SACRAMENTO AND FEATHER RIVERS.

July 1, 1906, balance unexpended.....	\$50. 88
December 18, 1906, amount received from sales.....	1, 613. 72
Amount appropriated by river and harbor act approved March 2, 1907.....	50, 000. 00
	<hr/>
June 30, 1907, amount expended during fiscal year, for works of improvement.....	51, 664. 60
	<hr/>
	328. 74
July 1, 1907, balance unexpended.....	51, 335. 86
July 1, 1907, outstanding liabilities.....	3, 075. 51
	<hr/>
July 1, 1907, balance available.....	48, 260. 35
	<hr/>
Amount (estimated) required for completion of existing project. Indeterminate.	

## SACRAMENTO RIVER.

July 1, 1906, balance unexpended-----	\$33,542.83
November 19, 1906, amount received from sales-----	16.16
	<hr/>
	33,558.99
June 30, 1907, amount expended during fiscal year, for works of improvement-----	14,900.75
	<hr/>
July 1, 1907, balance unexpended-----	18,658.24

(See Appendix V V.)

## IMPROVEMENT OF RIVERS AND HARBORS IN WESTERN OREGON, OF COLUMBIA RIVER ABOVE THE MOUTH OF WILLAMETTE RIVER, AND OF SNAKE RIVER, OREGON, WASHINGTON, AND IDAHO.

This district was in the charge of Lieut. Col. S. W. Roessler, Corps of Engineers. Division engineer, Col. W. H. Heuer, Corps of Engineers, to March 2, 1907.

1. *Coquille River, Oregon*.—This stream empties into the Pacific Ocean near Bandon, Coos County, Oreg., about 375 miles north of San Francisco, Cal.

Before improvement the bar channel skirted the south headland and crossed ground which was studded with dangerous rocks. It was also crooked. The depth over the bar was usually about 3 feet at low tide, or a little over 7 feet at high tide. Vessels which crossed the bar could ascend at high tide to the town of Coquille, about 25 miles above Bandon, and light-draft steamers could ascend the stream a farther distance of about 12 miles to the head of navigation at Myrtle Point. The usual range of the tide at Bandon is about 4.2 feet.

The original project of 1878 provided for the construction of two converging high-tide jetties of rubblestone, by which the ebb flow would be concentrated upon a limited portion of the bar. The projected width apart of the jetties was 800 feet and the expected depth 12 feet at deep low tide.

After the work had been carried to a certain point and the results noted, it was found necessary to reduce the width between the jetties from 800 to 600 feet and to reduce also the depth that would probably result from the improvement to 8 feet at low tide.

These changes and the fixation of the length of the south jetty at 2,700 feet and of the north jetty at 1,575 feet by the act of Congress approved July 13, 1892, constitute the present modified project.

The estimated cost of the project when completed, not including expenditures for maintenance, is \$306,200.

The amount expended prior to operations under the existing project was \$144,323.42, including \$6,883.90 for snagging and \$15,000 for repairs and maintenance.

The amount expended on the present project to the close of the fiscal year 1907 was \$291,775.99, of which approximately \$39,960.74 was applied to maintenance.

The results accomplished to date have been the completion of the south jetty to its projected length of 2,700 feet and in constructing about 1,290 feet of the north jetty, and this has resulted in closing up the dangerous old channel at the mouth of the river and provid-

ing a new channel straight out to sea, the controlling bar depth ranging from 6 to 9 feet at mean low tide. The completed south jetty and the partially completed north jetty have suffered no material damage during the year, except that the enrockment at the outer ends has been beaten down to some extent by the seas.

Operations during the fiscal year have been confined principally to care and maintenance of the plant and works, the expenditures being mostly on account of closing up the contract in force during the previous year. The funds for completing the work were made available too late to accomplish any results other than to advertise the work and make formal contract with the lowest responsible bidder for extending the north jetty.

The river and ocean form the only practicable means of transporting the commerce, the principal items of which are lumber, coal, live stock, and farm products. This commerce is loaded on small coasting vessels along the 25 miles of river between its mouth and Coquille, and is usually taken to the San Francisco market. The total amount of exports during the calendar year was 63,388 tons, valued at \$737,231. The principal articles of import are mill and farm machinery and general supplies, the amount of which was 3,900 tons, valued at approximately \$382,485.

References to former reports are given on page 259 of Annual Report for 1905.

*Comparative statement of traffic.*

Calendar year.	Tons.	Estimated value.	Calendar year.	Tons.	Estimated value.
1897.....	25, 620	.....	1902.....	37, 458	.....
1898.....	24, 556	.....	1903.....	48, 249	.....
1899.....	25, 654	.....	1904.....	60, 944	\$1, 322, 058
1900.....	30, 727	.....	1905.....	45, 455	1, 105, 750
1901.....	32, 975	.....	1906.....	67, 288	1, 119, 716

July 1, 1906, balance unexpended.....	\$12, 979. 35
Amount appropriated by river and harbor act approved March 2, 1907 .....	60, 000. 00

72, 979. 35

June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$8, 594. 60
For maintenance of improvement.....	1, 160. 74
	9, 755. 34

July 1, 1907, balance unexpended.....	63, 224. 01
July 1, 1907, outstanding liabilities.....	60. 00

July 1, 1907, balance available.....	63, 164. 01
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July 1, 1907, amount covered by uncompleted contracts.....	51, 778. 00
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(See Appendix W W 1.)

2. *Entrance to Coos Bay and Harbor, Oregon.*—Coos Bay is a tidal estuary on the Pacific coast in Oregon, about 400 miles north of San Francisco, Cal. Except Humboldt, it is the principal harbor between the mouth of the Columbia River and San Francisco. Before improvement the obstructions consisted of the usual bar in the ocean at the entrance to the bay and of shoals inside the bay near its en-

trance formed by sand which blows down the beach during north-westerly winds. The depth on the ocean bar was often but 10 feet at low tide.

The original project for the improvement of Coos Bay received the approval of the Secretary of War November 14, 1879. It provided for the construction of a jetty from a point about 250 yards below the southern extremity of Fossil Point, on a line toward the east end of Coos Head, this line curving so as to be directed at its outer end to the head or a little north of it, the structure to be of wood and stone, or stone, as should be found best. The estimated cost was \$600,000.

The amount expended on the original project was \$213,750, with which 1,760 feet of timber-crib and rubblestone jetty was built.

The existing project, adopted by act of Congress approved September 19, 1890, is that of a Board of Engineers, dated October 27, 1889, and it provided for obtaining and maintaining a channel 20 feet deep at low tide through the ocean bar at the entrance to the bay by confining the entrance between two high-tide rubblestone jetties, the north jetty to be 9,600 feet long and the south jetty 4,200 feet long.

The estimated total cost of the existing project, exclusive of the amount expended on the original project, is \$2,466,412.20. The amount expended thereon up to the close of the fiscal year ending June 30, 1907, is \$696,988.05, of which \$171,988.05 was for maintenance of improvement.

The expenditures on this improvement to date have resulted in the construction of the submerged jetty near Fossil Point under the original project, and in completing the 9,600-foot north jetty under the present project. The jetty tramway and wharf have been entirely destroyed by the teredo and wave action, and the enrockment has been more or less beaten down by the seas.

Since the completion of the north jetty a straight channel through the ocean bar has been maintained, having ordinarily a least depth of from 17 to 22 feet at mean low tide.

The controlling depth in the bar channel as determined by survey now in progress is about 20 feet at mean lower low tide. Between the bar and the town of Empire is a sandy shoal, on which the least channel depth is 14 feet at mean lower low tide. Above Bay City there is about 50 miles of available navigation for boats of light draft. The mean rise and fall of the tide is 4.8 feet.

The available funds are being withheld until such time as the necessity for their expenditure is shown, as the depths contemplated by the project have been obtained and fairly well maintained.

The act of March 2, 1907, authorized the construction of a dredge for use on the coast waters of Oregon and Washington, and as this dredge will soon be available it is recommended that the Secretary of War be authorized to apply so much of the available balance as may be necessary to the work of dredging the inner harbor.

No work has been done during the fiscal year 1907 aside from watching and caring for the plant and works and planting about 57 acres of Holland grass roots on the north spit.

The export commerce of Coos Bay consists principally of lumber products, coal, farm and dairy produce, live stock, and fish, and



amounted during the year to 153,541 tons, valued at approximately \$2,048,447. The lumber and coal is a growing and valuable industry, and the tonnage each year is increasing. The imports, consisting of farm and mill machinery and miscellaneous merchandise, amounted to 30,914 tons, valued at approximately \$2,951,570.

San Francisco is the principal market. At present the bay and ocean are the only means of transportation. There is, however, a good prospect that a branch road will be built in the near future to connect with the Southern Pacific system, which, when completed, will further develop the rich timber and mineral resources of the Coos Bay district. This railroad may diminish to some extent the water-borne traffic of the harbor, but it is not believed that the reduction will be enough to affect the standing of Coos Bay as an important seaport.

References to former reports are given on page 611 of the Annual Report for 1905.

*Comparative statement of traffic.*

Calendar year.	Tons.	Estimated value.	Calendar year.	Tons.	Estimated value.
1897.....	115,896	.....	1902.....	122,282	.....
1898.....	108,039	.....	1903.....	135,178	.....
1899.....	116,567	.....	1904.....	136,958	\$3,557,984
1900.....	104,294	.....	1905.....	178,945	3,901,906
1901.....	97,500	.....	1906.....	184,455	5,900,017

July 1, 1906, balance unexpended.....	\$26,801.53
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	1,525.54

July 1, 1907, balance unexpended.....	25,275.99
July 1, 1907, outstanding liabilities.....	50.00

July 1, 1907, balance available.....	25,225.99
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Amount (estimated) required for completion of existing project... 1,741,412.20

(See Appendix W W 2.)

3. *Coos River, Oregon.*—Coos River is the principal tributary of Coos Bay and empties into the bay at its head, opposite the town of Marshfield. At a point  $5\frac{1}{2}$  miles from its mouth the river divides into two branches, known as the North and South forks, up each of which tidal influence extends for about  $8\frac{1}{2}$  miles. Before improvement was commenced the small light-draft steamboats and launches plying between Marshfield and the head of tide on each fork experienced considerable difficulty in navigating on account of the many snags, bowlders, etc., in the stream.

The original plan of improvement, based on the survey made in 1894 (Annual Report of the Chief of Engineers for 1895, pp. 3502-3505), proposed the removal of all snags and bowlders from a selected channel 50 feet in width. The estimated cost was \$5,000, but in 1898 it was stated in the annual report that \$3,000 additional would be required to complete the project, and in 1900 it was estimated that an appropriation of \$1,500 every two years would be required for maintenance.

The act of March 3, 1905, provided funds by allowing transfer from balance remaining available to the credit of appropriation for

improving entrance to Coos Bay and Harbor, Oregon, and the act of March 2, 1907, appropriated a like sum to be expended on the approved project.

The amount expended on this work up to June 30, 1907, was \$12,366.30, of which \$4,366.30 has been applied to maintenance.

The work done during the past fiscal year, consisting entirely of snagging with the Government plant, was carried on in the summer and fall of 1906 and from the middle of May to the end of the fiscal year. To finish the season's work will take about four months.

The maximum draft that can be carried at low tide over the upper reaches of Coos River is about  $1\frac{1}{2}$  feet at low water. The range of tide is about  $2\frac{1}{2}$  feet, so that boats drawing 4 feet navigate to head of tide water on both the North and South forks, a distance of about 14 miles above the mouth.

Coos River flows through a narrow but productive valley and is the only means of transportation. The commerce is carried on small steamers to Marshfield, where it is loaded into ocean steamers and taken to San Francisco market. This commerce is mostly farm and dairy products, logs and lumber, and amounted during the year, including supplies, machinery, etc., received, to 35,537 tons, valued at approximately \$1,246,684.

*Comparative statement of traffic.*

Calendar year.	Tons.	Estimated value.	Calendar year.	Tons.	Estimated value.
1897.....	16,534	.....	1902.....	<sup>c</sup> 46,000	.....
1898.....	22,674	.....	1903.....	28,109	.....
1899.....	<sup>a</sup> 70,007	.....	1904.....	49,907	\$1,033,758
1900.....	<sup>b</sup> 229,225	.....	1905.....	44,398	1,179,974
1901.....	62,402	.....	1906.....	35,537	1,246,684

<sup>a</sup> Includes 21,852 tons of stone for the Government jetty at the entrance to Coos Bay, Oregon.

<sup>b</sup> Includes 170,400 tons of stone for the Government jetty at the entrance to Coos Bay, Oregon.

<sup>c</sup> Approximate.

July 1, 1906, balance unexpended..... \$2,569.26  
Amount appropriated by river and harbor act approved March 2, 1907..... 3,000.00

5,569.26

June 30, 1907, amount expended during fiscal year, for maintenance of improvement..... 1,935.56

July 1, 1907, balance unexpended..... 3,633.70  
July 1, 1907, outstanding liabilities..... 500.00

July 1, 1907, balance available..... 3,133.70

(See Appendix W W 3.)

4. *Mouth of Siuslaw River, Oregon.*—The Siuslaw River empties into the Pacific Ocean at a point about 475 miles north of San Francisco, Cal. It enters the sea through a shifting sand beach. The obstruction at the entrance is a shoal outer bar with deficient depth and a shifting channel through the bar, the latter, before the improvement, changing its position up and down the coast as much as 1 mile. The depth of water on the bar varied from 5 to 12 feet at low tide.

On August 4, 1891, the Secretary of War approved a project for improvement which provided for the construction of two rubblestone high-tide jetties 7,500 feet and 5,600 feet long, respectively, on the

north and south sides of the entrance. The estimated cost of the improvement was \$700,000. By these jetties it was expected to keep the channel in a fixed position and to increase the depth to 8 feet at low tide in the bar channel.

This project has been only partially carried out. Four thousand and ninety feet of the north jetty has been built, at a cost of \$151,700.83 in original construction and \$10,611.27 in maintenance, surveys, etc. Nothing has been done on the south jetty. The north jetty has had the effect of somewhat checking the tendency of the bar channel to shift its position as far to the north as frequently occurred before the jetty was built, but the expected depth at low tide in the bar channel has not been realized.

Upon the recommendation of the Board of Engineers for Rivers and Harbors, Congress provided in the river and harbor act of March 3, 1905, that the unexpended balance shall be returned to the Treasury, except an amount sufficient for maintenance for two years. This period of maintenance has elapsed and the balance remaining unexpended will be turned into the general fund of the Treasury at an early date.

Further information regarding the details of this improvement is given in the Annual Report for 1906, page 738.

*Comparative statement of traffic.*

Calendar year.	Tons.	Estimated value.	Calendar year.	Tons.	Estimated value.
1897.....	2, 239	.....	1902.....	25, 213	.....
1898.....	1, 350	.....	1903.....	25, 337	.....
1899.....	4, 907	.....	1904.....	24, 816	\$584, 146
1900.....	18, 675	.....	1905.....	13, 090	259, 165
1901.....	22, 351	.....	1906.....	14, 344	358, 890

July 1, 1906, balance unexpended..... \$24, 838. 00

July 1, 1907, balance unexpended, reverting to Treasury..... 24, 838. 00

(See Appendix W W 4.)

5. *Yaquina Bay, Oregon.*—Yaquina Bay is a small tidal estuary of about 5 square miles area lying on the Oregon coast about 110 miles south of the mouth of the Columbia River. The usual bar exists in the ocean at the entrance to the bay. Prior to improvement the prevailing depth on this bar was 7 or 8 feet at low tide, and three distinct channels existed at the entrance to the bay.

The original project for the improvement of Yaquina Bay was approved by the Secretary of War January 14, 1891. This project, as subsequently modified and as approved by act of Congress June 6, 1900, provided for the construction of two rubblestone jetties on the north and south sides for concentrating the ebb flow upon a limited portion of the bar and for the removal of a cluster of rocks located about 2,000 feet beyond the sea end of the south jetty. As completed, the length of the south jetty is 3,500 feet, and of the north jetty, 2,800 feet. The project has been completed at an expenditure of \$690,000 and has resulted in closing up two of the three channels formerly existing, and in developing the third channel with a depth varying from 13 to 15 feet of water on the bar at mean low tide, or

from 21 to 22 feet at high tide. This is in excess of the original project, which contemplated only 17 feet at high tide.

The existing project was adopted by Congress June 6, 1900, and provided for removal of a cluster of rocks about 2,000 feet beyond the sea end of the south jetty, at an estimated cost of \$20,000. This project has been completed. The expenditure to June 30, 1907, was \$20,228.02, of which \$6,025.51 was for maintenance.

Upon recommendation of the Board of Engineers for Rivers and Harbors, Congress provided, by the act of March 3, 1905, that the unexpended balance shall be returned to the Treasury, excepting such amount as might be required for maintenance for a period of two years. This period has expired, and the balance remaining of the appropriation will be turned into the general fund of the Treasury at an early date.

Further details regarding this improvement will be found on page 740 of the Annual Report for 1906.

*Comparative statement of traffic.*

Calendar year.	Tons.	Estimated value.	Calendar year.	Tons.	Estimated value.
1897.....	15,364	.....	1902.....	1,152	.....
1898.....	10,380	.....	1903.....	835	.....
1899.....	5,990	.....	1904.....	1,113	\$67,826
1900.....	691	.....	1905.....	573	49,180
1901.....	576	.....	1906.....	582	20,700

July 1, 1906, balance unexpended..... \$1,661.04

July 1, 1907, balance unexpended, reverting to Treasury..... 1,661.04

(See Appendix W W 5.)

*6. Tillamook Bay and bar, Oregon.*—Tillamook Bay lies on the Oregon coast, about 50 miles south of the Columbia River. It is about 6 miles long by 3 miles across in the widest part. The bar in the ocean at the entrance has generally a controlling channel depth of about 14 feet at mean low tide. The greater part of the area of the bay itself is taken up by mud flats, which are bare at low tide and separated by four principal channels which shoal to a low-water depth of but 1 or 2 feet near the east end of the bay.

Coasting vessels drawing from 14 to 15 feet can reach Hobsonville, on the north channel, a short distance inside the entrance.

The town of Tillamook, the most populous place on the bay and the distributing point for a very fertile valley, is situated on Hoquarten Slough, about 12 miles from the entrance, and can be reached at high tide by vessels drawing about 10 feet. Originally the controlling high-water depth between the ocean and town of Tillamook did not exceed 7 or 8 feet.

The original project for the improvement of Tillamook Bay was approved by the War Department October 4, 1888, and provided for a survey of the entrance and for the improvement of Dry Stocking bar in Hoquarten Slough by the building of pile dikes at an estimated cost of \$5,200.

The total expenditures on the original project amounted to \$5,700.

The existing project, printed in the Annual Report of the Chief of Engineers for 1892, pages 2742-2752, provided for connecting the

north and middle channel, nearly opposite Bay City, putting in dikes at Junction and Dry Stocking bars, and contemplated a least depth in the channel of 9 feet at mean high tide from Hobsonville up to Tillamook. The estimated cost was \$100,000.

The total amount expended on the work up to the close of the fiscal year ending June 30, 1907, was \$116,958.02, of which \$43,484.65 was for maintenance and \$3,816.67 for dredging, snagging, etc., which resulted in maintaining the projected depth of at least 9 feet in the channel between Bay City and the town of Tillamook.

No operations were carried on during the fiscal year until May, when the work of snagging in Hoquarten Slough was taken up, and at the close of the year was still in progress, it being the intention to commence dredging operations as soon as the channel is thoroughly snagged.

The maximum draft that can be carried at low water over the shoalest part of the channel is about  $3\frac{1}{2}$  feet. The average range of the tide is 6.2 feet. The head of navigation is Tillamook, about 12 miles from the entrance.

The commerce of Tillamook Bay consists chiefly of lumber and dairy products exported to Portland and San Francisco and general merchandise brought in by coasting vessels. During the fiscal year this traffic amounted to 13,627 tons, valued at approximately \$850,240.

There is no railroad in the vicinity at this time, and the bay and ocean afford the only means of transportation. A railroad from Hillsboro to Tillamook Bay has been commenced and the track laid for the first few miles.

References to former reports are given on page 668 of the Annual Report for 1905.

*Comparative statement of traffic.*

Calendar year.	Tons.	Estimated value.	Calendar year.	Tons.	Estimated value.
1897.....	29,405	.....	1902.....	24,883	.....
1898.....	35,885	.....	1903.....	16,862	.....
1899.....	36,885	.....	1904.....	13,823	\$658,489
1900.....	17,640	.....	1905.....	13,919	689,760
1901.....	21,147	.....	1906.....	13,627	850,240

July 1, 1906, balance unexpended.....	\$2, 563. 33
Receipts from sales.....	20. 00
Amount appropriated by river and harbor act approved March 2, 1907.....	10, 000. 00

12, 583. 33

June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	3, 816. 67
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July 1, 1907, balance unexpended.....	8, 766. 66
July 1, 1907, outstanding liabilities.....	1, 100. 00

July 1, 1907, balance available.....	7, 666. 66
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(See Appendix W W 6.)

7. *Improving the various harbors on the coasts of Oregon and Washington by the construction and equipment of a dredging plant for use thereon.*—The harbors and rivers upon which improvements are in progress, or upon which the improvements already completed

require periodical work for their maintenance, are Tillamook Bay and bar, Coos Bay and Harbor, Coquille River, Oregon, and Grays Harbor, Willapa Bay, and certain other works in Washington.

Navigation is often greatly delayed by the forming of shoals, the material deposited in most instances being of such a nature that it can not be easily handled with a dipper dredge.

Reference to the need for a suitable dredge for dredging in the coast harbors of Oregon was referred to in the Annual Report of 1906, and an estimate of \$60,000 submitted for its construction. This estimate was later changed to \$100,000, and the river and harbor act of March 2, 1907, appropriated that sum for constructing the plant to be used in the harbors and coast waters of Oregon and Washington, and to be operated and maintained out of funds available for such harbors and coast waters.

The plans and specifications for the dredge were practically completed and ready for advertising and circulation among bidders at the end of the fiscal year.

Amount appropriated by river and harbor act approved March 2,

1907	-----	\$100,000.00
July 1, 1907, balance unexpended	-----	100,000.00

(See Appendix W W 7.)

8. *Upper Columbia and Snake rivers, Oregon, Washington, and Idaho.*—The designation "upper Columbia and Snake rivers" includes the 124 miles of the Columbia River between the falls at Celilo, Oreg., and the mouth of the Snake River, and the 216 miles of the Snake River between its mouth and Pittsburg Landing, a total distance of 340 miles. Between these limiting points the two streams form a continuous waterway which is susceptible of open-river navigation at favorable stages as far as the mouth of the Imnaha River, 24 miles below Pittsburg Landing. The difficulties of navigation are the many rapids which exist throughout the entire length of this waterway, especially in the upper reaches of the Snake River. In some of these rapids the current is moderate, but in others it is very swift and impossible of ascent by any but the swiftest boats. Some of the channels through the rapids are crooked and narrow and all of them are shoal with a ruling depth of 2 to 3 feet at low water between Celilo and Lewiston, and a lesser depth above that point. A detailed description of the rivers may be found on page 2293 of the Annual Report of the Chief of Engineers for 1880, and page 3211 of the Annual Report for 1891.

Before the days of railroads this stretch of waterway, in connection with the lower reaches of the Columbia and portage road at Celilo and the Cascades, formed the main highway of commerce between eastern and western Oregon and a large amount of navigation was carried on for that time. This navigation continued until 1882 and was then practically suspended by the paralleling of the river by the Oregon Railroad and Navigation Company's railroad. The only stretch of river upon which navigation was continued after that date, and has continued up to the present time, is the 76 miles of the Snake River between the point of railroad crossing at Riparia Junction and the important city of Lewiston, Idaho. This suspension of traffic on the lower Snake below Riparia Junction and upper

Columbia River between the mouth of the Snake and Celilo continued from 1882 until the revival of interest in open-river navigation by the completion of the portage railroad at Celilo by the State of Oregon in 1905. The main purpose of this road was to provide open-river competition with points above Celilo until through steamboat traffic can be established by the construction of The Dalles-Celilo canal by the General Government, and while the competition so far set up has not been a controlling factor in regulating rates on freight, it has effected a reduction of rates at certain points and would doubtless have effected a still greater reduction if there had been available larger and better steamboats than have so far been provided.

There has been no comprehensive plan of improvement adopted for this entire stretch of river, but improvements have been made at certain points from time to time under special projects. Before 1877 the sum of \$120,000 was appropriated and expended in removing rock at the principal rapids in the Columbia River and for making detached surveys. In 1877 a project was approved for removing reefs and bowlders and scraping gravel bars in the Columbia and Snake rivers between Celilo and Lewiston at an estimated cost of \$132,000. As modified in 1902, this latter project is practically limited to the portion of the river between Riparia Junction and Lewiston as being the only part of the waterway upon which regular navigation is being carried on.

There are at present three projects operative upon this line of waterway. The first is that of 1877, as modified in 1902, under which it is proposed to improve the Snake River between Riparia and Lewiston with a view to obtaining 5 feet depth at low water by means of dredging and raking gravel bars and constructing works for contracting the waterway in wide sections and for general improvement of the Snake River between Lewiston and Pittsburg Landing by removing obstructing rocks and bowlders.

The second project is for improving the Snake River between Riparia Junction and its mouth, and is intended to facilitate navigation by removing bowlders and ledges in narrow and shoal places and scraping gravel bars. It was formulated for the purpose of expending an appropriation of \$100,000 by the State of Washington at the last session of the legislature and was submitted to the State legislature before the appropriation was made.

The third project is the one adopted by Congress in the river and harbor act of March 2, 1907, which provides for an expenditure during a series of years of the sum of \$400,000 in open-river work in the Columbia River between the mouth of the Snake and Celilo. A part of this project will be the expenditure of \$25,000 appropriated by the last legislature of the State of Washington in aiding in improving the Umatilla Rapids.

These three improvements, taken together and as now carried on, form practically one continuous project, the purpose of which is to facilitate navigation by removing obstructing bowlders and ledges and in a few isolated places raking bars and to make safe and available for all but low stages the depths that now exist, rather than to develop any considerable depth at the lowest stage of river.

The operations under the first-mentioned project during the past fiscal year have resulted in providing a low-water channel 40 inches

deep between Riparia and Lewiston, which could have been utilized throughout the entire season by boats of suitable design for swift and shoal water rivers. Despite the good channel obtained, navigation was suspended during a portion of the low-water season for the alleged reason that boats could carry only reduced cargoes and that the boats themselves were subjected to considerable wear and tear. The boats now used are owned by the Oregon Railroad and Navigation Company and are not suitably designed for use on shoal and swift water streams.

The operations under the second-mentioned project during the past fiscal year consisted in preparing plans and making contracts for the necessary plant. This plant will consist of three scows, equipped with derrick, engines, hoists, and spuds and steam drills, suitably designed for removing rocks and bowlders from the rapids. It is hoped to obtain this plant, or at least a portion of it, in time to be of use during a part of the coming low-water season.

Under the third above-mentioned project plans are being prepared for a steamboat, equipped with spuds, derrick, channel rake, and machine drills, which will also act as tender to the drill scows which are to be located at different points in the Columbia and Snake rivers during the working season. It is expected to have this tender boat ready for operation before the working season of 1908.

The amount expended on the original and modified projects up to the close of the fiscal year 1907 was \$373,143.48, of which \$14,747.08 was expended during the fiscal year on raking gravel shoals and bettering the conditions above Riparia.

These improvements extend over a continuous waterway, and it is recommended that future appropriations be made available at the discretion of the Secretary of War for any portion of the waterway between the limiting points.

The commerce transported on the Columbia and Snake rivers during the fiscal year amounted to 71,556 tons and consisted principally in farm and mill machinery, grain, fruit, and general merchandise. The value of these commodities is estimated at \$2,671,882.

References to former reports will be found on page 745, Annual Report for 1906, and a map of the river is published in the Annual Report for 1906, page 1988.

The project for improvement between Celilo and mouth of Snake is printed in House Document No. 440, Fifty-ninth Congress, second session.

*Comparative statement of traffic.*

Calendar year.	Tons.	Estimated value.	Calendar year.	Tons.	Estimated value.
1897.....	31,531	.....	1902.....	37,824	.....
1898.....	36,923	.....	1903.....	44,379	.....
1899.....	45,654	.....	1904.....	43,547	\$1,798,677
1900.....	35,920	.....	1905.....	28,380	1,191,960
1901.....	36,723	.....	1906.....	71,556	2,671,882



# REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

1906, balance unexpended.....	\$13, 973. 71
Amount appropriated by river and harbor act approved March 2, 1907:	
Columbia River to mouth of Snake River.....	120, 000. 00
Snake River above Riparia.....	10, 000. 00
	<hr/>
1907, amount expended during fiscal year, for maintenance improvement.....	143, 973. 71
	<hr/>
1907, balance unexpended.....	129, 226. 63
1907, outstanding liabilities.....	900. 00
	<hr/>
1907, balance available.....	128, 326. 63
Amount (estimated) required for completion of existing project....	Indefinite.
	<hr/>
Amount appropriated by the Washington State legislature.....	125, 000. 00
	<hr/>
1907, balance unexpended.....	125, 000. 00
1907, outstanding liabilities.....	2, 739. 00
	<hr/>
1907, balance available.....	122, 261. 00
	<hr/>
1907, amount covered by uncompleted contracts.....	16, 331. 00

See Appendix W W 8.)

1. *Columbia River between the foot of the The Dalles Rapids and head of Celilo Falls, Oregon and Washington.*—In this stretch of river navigation is rendered difficult at Threemile Rapids, 2 miles above The Dalles, where for 1,500 feet the channel is crooked and narrow and much obstructed by submerged rocky reefs. Two miles farther up is the obstruction of Fivemile Rapids (The Dalles). Here for 1½ miles the river runs with great velocity between precipitous basaltic walls from 150 to 200 feet apart. Five miles farther up is the obstruction of Tenmile Rapids, a similar gorge one-half mile in length, and finally at Celilo Falls there is a sheer fall of 20 feet at low water. Between the limiting points the river falls through a vertical height of 81 feet at low water and 60 feet at high ages. The object of the improvement is to overcome these obstructions so as to provide continuous steamboat navigation between the pool at The Dalles and the pool above Celilo.

The first project was adopted by Congress August 18, 1894, and provided for a boat railway. The second project was for short canals with locks around Fivemile Rapids and Celilo Falls. This project is printed in Annual Report of Chief of Engineers for 1901, page 3502.

The present project was made by a Board of Engineer officers and was approved by the Secretary of War November 6, 1903, and adopted by Congress March 3, 1905. This project is for a continuous canal on the Oregon shore from Celilo Falls to Big Eddy, with open-river improvement at Threemile Rapids, at an estimated cost of \$4,125,000. The canal proposed by the Board has a length of about 8½ miles and is about 65 feet wide on the bottom, 8 feet deep, with locks 250 feet long between hollow quoins and 40 feet wide in the clear and 7 feet deep over miter sills. The details of the project as approved by the Chief of Engineers May 5, 1905, include a provision for locks of 300 feet between hollow quoins and a clear width of 45 feet. Late data as to character of foundation have necessitated a revision of the plan, upon which the district officer is engaged.

Two contracts were in force at the end of last fiscal year and both contracts are still in operation.

The first contract is dated April 12, 1904, and provides for the removal of rock ledges from the vicinity of Threemile Rapids so as to give a channel at least 10 feet deep at low water and not less than 250 feet wide, save at one point where it is to be 200 feet wide. A total of 45,964 cubic yards of rock has been taken out under this contract, leaving an estimated balance of 6,612 cubic yards of excavation to complete the contract. This should be taken out and the contract completed this coming season. Last season was very unfavorable for subaqueous operations on account of the river fluctuations and only ninety-five days of active work were put in. The contract period has been waived so as to give the contractor time to finish all the excavation called for.

The second contract is dated August 10, 1905, and it provides for constructing about one-half mile of the canal near the upper end at Celilo, and includes one boat basin and one lock chamber, but not the lock gates nor the maneuvering machinery. The contractors, Messrs. Smyth & Jones, have managed the work poorly and have made very slow progress, accomplishing less than one-half the contract requirements before the contract expired January 1, 1907. As the prices paid them are very favorable to the United States and as the section of canal under construction will be of no benefit until the entire canal is completed some years hence, the contract period has been waived for a reasonable time and the contractors allowed to go on with the work. The work of the year comprised 21,423 cubic yards of solid-rock excavation, 5,403 cubic yards common excavation, 4,428 cubic yards sand excavation, and 4,583 cubic yards of concrete. Work was suspended April 12 by the summer freshet and will be resumed about August.

The amount expended to June 30, 1907, was \$287,308.50, of which \$27,112.83 was applied on the earlier projects, \$31,279.81 in surveying and preparing plans for the latest project, and \$228,915.86 on the existing project.

The river and harbor act approved March 2, 1907, appropriated \$100,000 and authorized a continuing contract for \$500,000 additional to continue work on the canal. This sum and available balances from previous appropriations will be expended in extending downstream the canal section already begun under Smyth & Jones's contract. This work will not be advertised until the freshet subsides and the ground over which the new work will extend can be inspected.

The amount estimated as a profitable expenditure is the \$500,000 authorized by the act of March 2, 1907, for continuing contract and will be applied to continuing the canal section below that to be built under appropriations already made.

The fluctuation in water surface from extreme low water to extreme high water varies from 32 to 90 feet at different points in the short stretch of river from Celilo to The Dalles. River boats can now reach Big Eddy, nearly 4 miles above The Dalles, at favorable stages, and a limited amount of freight has been transferred between steamers and the portage railway at Big Eddy and between the portage road and a single steamer operating during the past season above Celilo. The influence of this traffic has already resulted in a reduction of the freight rates as far as the traffic over the portage

road and its connecting steamer above has extended, and a still further reduction is anticipated as the steamboat service in the upper river is increased.

The Portland and Seattle Railway Company, a corporation under the joint control of the Northern Pacific and Great Northern Railway companies, is now constructing a line of road along the north bank of the Columbia River between Kennewick, Wash., and Portland, Oreg.

The benefits to be derived from the completion of the proposed improvement, the country to be affected, and the probable resources to be developed, with maps, etc., are given in House Document No. 228, Fifty-sixth Congress, second session. Irrigation projects now contemplated should within a few years further increase the farm products, and it is expected that the improvement will reduce present freight rates on large quantities of produce annually shipped by rail from the extensive territory drained by the upper Columbia and Snake rivers.

References to former reports are given on page 673 of the Annual Report for 1905.

*Comparative statement of traffic handled by Oregon State Portage Railway between Big Eddy and Celilo, Oreg.*

Calendar year.	Tons.	Estimated value.	Calendar year.	Tons.	Estimated value.
1905.....	3,058	\$185,800	1906.....	5,414	\$227,900

July 1, 1906, balance unexpended.....	\$434,900.46
Receipts from sales.....	4.90
Amount appropriated by river and harbor act approved March 2, 1907.....	100,000.00
	<hr/> 534,905.36
June 30, 1907, amount expended during fiscal year, for works of improvement.....	72,208.96
	<hr/> 462,696.40
July 1, 1907, balance unexpended.....	462,696.40
July 1, 1907, outstanding liabilities.....	20,100.00
	<hr/> 442,596.40
July 1, 1907, balance available.....	<hr/> 442,596.40
July 1, 1907, amount covered by uncompleted contracts.....	220,904.00
Amount (estimated) required for completion of existing project..	3,433,392.64
	<hr/> <hr/>
{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907.....	500,000.00
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

(See Appendix W W 9.)

10. *Canal at the Cascades, Columbia River, Oregon.*—This improvement embraces about 4½ miles of the Columbia River where it passes through the Cascade Mountain Range and where it is contracted into the narrow width of a gorge with steep slope and swift current. A fall of 24 feet at low water and a lesser fall at high water in the upper 2,500 feet of the gorge creates a fearful rapid, whose swift current, rushing over many obstructing bowlders, effect-

ually bars upstream navigation and renders downstream navigation unsafe. In the lower 4 miles of the gorge the river is not so narrow and the current not so swift as in the upper half mile; but even here navigation was unsafe in the unimproved river by reason of obstructing ledges and boulders, upon which vessels were liable to be swept by a very swift current. The improvements made consist in the construction of locks around the steep rapids at the upper end of the gorge and in open-river work, such as blasting out ledges and boulders in the lower 4-mile section.

The original project was for a canal and locks around the falls and was adopted in 1877 and modified in 1886 and 1888, and included the improvement of the rapids below the falls to secure a low-water channel of 8 feet. The locks were about 462 feet long and 92 feet wide, with a low-water depth of 8 feet over the miter sills.

The project was again modified in 1894 to provide for utilizing the upper 426 feet of the uncompleted canal above the lock gates as a second lock. It provided for raising the protection work of the canal walls as a safeguard against flood waters, which in that year reached a height of 6 feet above previous known high water.

The estimated cost of the original project was \$2,544,545, and of this latter modification \$413,360.

The construction of the canal and locks was carried on both by hired labor and purchase of material and by contract, and they were first opened to navigation in the fall of 1896, with walls and slope revetments still incomplete.

The amount expended on the original and modified projects up to the close of the fiscal year ending June 30, 1907, was \$3,818,369.63, and includes the construction, under contract, of five new buildings, viz, three dwellings for the lock tenders, one stable, and one combined carpenter and machine shop.

The amount estimated as required to complete the walls and place the grounds in good condition is \$199,260, and this work includes the raising of the land wall of the upper lock, constructing three sets of steps, and completing the paving and grading on the land side of the canal. Provision should also be made for the construction of one office building and for blasting out some obstructive rocks in the channel below the lower entrance.

The expenditures during the fiscal year were on account of care and maintenance of works and plant used during construction.

The head of navigation for boats passing the locks has heretofore been Threemile Rapids,  $1\frac{1}{2}$  miles above The Dalles, but may now be said to be at Big Eddy by reason of the improvements already made under the contract in force for removing dangerous rocks at Threemile Rapids (see report on improving Columbia River between the foot of The Dalles Rapids and the head of Celilo Falls, Oregon and Washington).

The maximum draft that can be carried through the locks at the close of the fiscal year is about 6.5 feet at low water, owing to deposit on the canal floors.

The yearly rise in the Columbia takes place in May, June, or July, and its usual height above extreme low water is about 40 feet.

The down-river commerce through the locks consists principally of wheat, flour, miscellaneous grain, cattle, horses, wool, and country produce. The amount of this commerce for the fiscal year was 27,081 tons, valued at approximately \$1,624,860.

The up-river commerce is principally general merchandise, machinery, and railroad supplies, consisting of 26,689 tons, valued at approximately \$1,601,340.

References to former reports are given on page 675 of the Annual Report for 1905.

*Comparative statement of traffic.*

Fiscal year ending June 30—	Tons.	Estimated value.	Passen- gers.	Fiscal year ending June 30—	Tons.	Estimated value.	Passen- gers.
1898 .....	18,812	.....	30,327	1903.....	36,181	.....	50,821
1899 .....	16,700	.....	23,908	1904.....	31,967	.....	76,971
1900 .....	17,710	.....	30,639	1905.....	35,166	\$2,286,125	64,403
1901 .....	22,426	.....	34,762	1906.....	46,884	2,813,040	133,070
1902 .....	19,710	.....	52,720	1907.....	53,770	3,226,200	89,239

July 1, 1906, balance unexpended.....	\$4,005. 08
Receipts from sales .....	229. 78

4, 234. 86

June 30, 1907, amount expended during fiscal year, for maintenance of improvement .....	1, 975. 01
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July 1, 1907, balance unexpended.....	2, 259. 85
July 1, 1907, outstanding liabilities.....	80. 00

July 1, 1907, balance available.....	2, 179. 85
Amount (estimated) required for completion of existing project....	199, 260. 00

(See Appendix W W 10.)

11. *Operating and care of canal and locks at the Cascades of the Columbia River, Oregon.*—The canal and locks around the obstructions in the Columbia River at Cascades, Oreg., were so far completed that they were opened to navigation on November 5, 1896, since which time appropriations have been made under the general work of improvement for further completing the walls and slope, pavement, grading, etc. A general description of the location, dimensions, etc., is given in the preceding report.

The total amount expended from the indefinite appropriation for operating and caring for the locks and in making repairs to the machinery, valves, etc., to the end of the fiscal year 1907, was \$84,077.54.

During the fiscal year the sum of \$9,954.81 was expended on salaries of lock keepers, in repairing the valve on north side of lower lock gate, and in installing fenders on the lock walls. The machinery was installed on the new dredge and the dredge got ready for service, except the spuds which will be added later. Very little dredging was required during the year.

The new sand-blast machine and the lighting plant for the buildings and quarters, which have been authorized and allotment made therefor, will be installed during the coming summer.

The commerce through the locks during the fiscal year amounted to 53,770 tons, valued at approximately \$3,226,200. This commerce consisted principally of wheat, flour, miscellaneous grain, cattle, horses, wool, country produce, general merchandise, machinery, and railroad supplies, a detailed statement of which is given in the district officer's report.

(See Appendix W W 11.)

12. *Columbia River between Vancouver, Wash., and the mouth of Willamette River.*—The city of Vancouver, Wash., is located on the Columbia River 103 miles above its mouth and 5 miles above the junction of the Willamette and Columbia rivers. The average range of tide at Vancouver during low stages of river is eight-tenths of a foot and the average summer freshet rise, which generally occurs in June, is about 20 feet. Vessels drawing 23 feet could ascend the Columbia to a point  $2\frac{1}{2}$  miles below the city, but could go no farther because of a sand bar which had but 9 feet over it at lowest stage of river before any improvement was attempted.

The purpose of the improvement is to deepen the water over the aforesaid sand bar, and this has been accomplished partly by contraction dike and partly by dredging.

The project of 1892 provided for the construction of a pile, brush, and rubble-stone dike about 3,000 feet long across the head of Oregon (Hayden Island) Slough, to cut off the flow through the slough at low stages of river and to produce a corresponding concentration of current and scouring effect over the obstructing sand bar in the main river.

It was hoped to obtain by this increased scour a sufficient depth to enable vessels drawing 20 feet or more to reach the wharves at Vancouver, but this expectation was not fully realized and a modification of the project was adopted by Congress in the river and harbor act approved March 3, 1905. This modification was based upon a report of the Board of Engineers for Rivers and Harbors dated July 22, 1902, and provided for dredging a channel 150 feet wide and 20 feet deep through the shoal below Vancouver at an estimated cost of \$60,000 for original dredging and \$10,000 for maintenance.

This channel was dredged in 1905 to the projected width and depth. As anticipated, there was considerable shoaling by new sand deposits throughout the entire length of the dredged channel. At places this new deposit was 5 to 6 feet in depth, giving an available depth at lowest river of 14 to 15 feet after the freshet. The channel was again restored to original width and depth from October, 1906, to January, 1907, by the removal of 253,000 cubic yards of sand, at a cost of approximately 4 cents per cubic yard.

No repairs were required to the dike during the year.

The work to be done this coming year will be the annual dredging over the Vancouver bar and such repairs as the dike may be found in need of after the present freshet subsides.

The total amount expended on the original and modified projects to June 30, 1907, was \$142,473.94, of which sum \$44,940.78 has been applied to maintenance.

Steamboats drawing 8 feet can navigate the river as far as The Dalles, about 210 miles from its mouth, by passing through the locks at the Cascades.

Vast forests of virgin timber are within easy reach of Vancouver, and the country also produces great quantities of fruit, hay, grain, etc. Vancouver has railroad connections, and a line is now being constructed down the north bank of the Columbia from Kennewick, Wash., to Portland, Oreg., crossing the Columbia by bridge just below Vancouver. It is not believed that the improvement will affect rates on local or transcontinental shipments.

The balance on hand will be applied to maintaining the dredged channel and the dike.

The deep-sea tonnage from Vancouver is lumber, shipped principally by coasting vessels, and during the calendar year 1906 amounted to about 15,000,000 feet, valued at approximately \$225,000.

References to former reports are given on page 677 of the Annual Report for 1905.

July 1, 1906, balance unexpended.....	\$22, 495. 94
June 30, 1907, amount expended during fiscal year, for maintenance of improvement .....	11, 968. 88
July 1, 1907, balance unexpended.....	10, 527. 06
(See Appendix W W 12.)	

EXAMINATION AND SURVEY MADE IN COMPLIANCE WITH RIVER AND  
HARBOR ACT APPROVED MARCH 3, 1905.

Reports dated March 31, 1905, and November 27, 1906, required by the river and harbor act of March 3, 1905, on preliminary examination and survey of *Columbia River between Celilo Falls, Oregon, and mouth of Snake River, Washington*, were submitted by the district officer and were reviewed by the Board of Engineers for Rivers and Harbors pursuant to law. They were transmitted to Congress and printed in House Document No. 440, Fifty-ninth Congress, second session. A plan for improvement at an estimated cost of \$400,000, and \$30,000 annually for maintenance, is presented.

IMPROVEMENT OF WILLAMETTE RIVER AND OF COLUMBIA RIVER  
BELOW THE MOUTH OF THE WILLAMETTE, AND THEIR TRIBU-  
TARIES, OREGON AND WASHINGTON.

This district was in the charge of Lieut. Col. S. W. Roessler, Corps of Engineers. Division engineer Col. W. H. Heuer, Corps of Engineers, to March 2, 1907.

1. *Willamette River, above Portland, and Yamhill River, Oregon.*—The Willamette River in years past has been navigated with difficulty as far southward as Eugene, 172 miles above Portland, Oreg., but of late years the practical head of steamboat navigation has been Harrisburg, 152 miles above Portland. On the tributary Yamhill the head of navigation is at McMinnville, 18 miles above its mouth and 59 miles from Portland. The Long Tom River, also a tributary of the Willamette, 122 miles above Portland, is no longer used for navigation.

Prior to improvement these rivers were obstructed by drift, snags, rock ledges and rapids, and gravel shoals, which prevented navigation during low-water periods. A full description of the Willamette River, together with a detailed statement of its condition previous to improvement, may be found in the Annual Report of the Chief of Engineers for 1876, page 654, and for 1880, page 2280.

The original project for improvement, adopted in 1870, and modified in 1878, provided for the removal of snags from Eugene to Portland, the deepening of gravel shoals by scraping and by contraction works, and the removal of rock by blasting.

In 1896 a further modified project was made to include the removal of low-water obstructions in the Yamhill River by the construction of a lock and dam 8 miles above its mouth, and provided for snagging and for the systematic contraction of the Willamette River by dam construction, with a view to obtaining a 12-foot low-water depth from Portland to Oswego (8 miles),  $2\frac{1}{2}$  feet between Oswego and Corvallis (111 miles), and 2 to  $2\frac{1}{2}$  feet between Corvallis and Eugene (53 miles). While the construction of controlling works under this project afforded some relief and alone made navigation possible at the low-water season during recent years, the depths proposed have not been realized.

The present revised plan of improvement (see Annual Report, Chief of Engineers for 1904, p. 3529) provides for improving the Willamette below Corvallis, with a view of obtaining, mainly by dredging, with auxiliary dam and revetment construction, and by snagging, a low-water depth of  $2\frac{1}{2}$  to  $3\frac{1}{2}$  feet from Corvallis to Oswego, and a low-water depth of 12 feet thence to Portland. Operations above Corvallis are to be confined to snagging as far as Harrisburg, and the river above that point is to be left as not worthy of further open-river improvement on account of its excessive slope (108 feet in 24 miles) and the lack of traffic at the present time. It has been found impracticable to outline a plan for permanent improvement which can be completed at a given cost, but an estimate of \$213,500 has been presented for carrying on the work as indicated.

The upper Willamette River is now navigable during high water to Harrisburg, 152 miles above Portland; during the medium water stages to Corvallis, 119 miles above Portland, and during extreme low water, with aid of dredging, to Independence, 83 miles above Portland. At the close of the fiscal year, with the river at less than a  $1\frac{1}{2}$ -foot stage, boats drawing 24 to 30 inches are making regular trips to Corvallis. The Yamhill River is continuously navigable for boats of 3-foot draft to McMinnville, except at certain stages of high water, when the lock is overflowed and the fall over the dam is too great to permit navigation in the river.

The variation of level of water surfaces on the Willamette at Salem from extreme summer low water to winter high water is 23 feet, and on the Yamhill below the lock and dam 35 feet.

The amount expended on the original project was \$247,747.51. The amount expended on the project of 1896 and the present revised project of 1904 up to the close of the fiscal year ending June 30, 1907, was \$336,412.80. This amount includes \$3,000 expended on the improvement of the Long Tom River and \$130,792.12 for maintenance in snagging, constructing, and operating the dredge and making repairs to the dams and floating plant.

Operations during the fiscal year consisted in dredging, snagging, and making repairs to dams, which work provided low-water navigation to Salem and Independence, and although very light-draft boats could have navigated to Corvallis during the entire year navigation to the latter point was suspended during the low-water season.

Besides providing for annual maintenance of the channel by dredging, snagging, and repairs to existing dikes and revetments, it is recommended that provision be made for constructing a revetment opposite Albany and extending the existing revetment at Independence,



both works being deemed essential for the purpose of maintaining the existing alignment of the banks and channels in these vicinities.

The commerce of the Willamette Valley consists of farm products, which are raised on the rich land adjacent to the river and generally shipped to the Portland market. The adjacent forests also produce a large supply of logs and timber, which is brought down to the river in annually increasing quantities, the products being either shipped by boat or floated to the sawmills along the river or to the paper pulp mills at Oregon City.

The amount of traffic handled by steam craft on the Willamette River during the calendar year 1906, which includes some saw logs towed, was 383,911 tons, valued at approximately \$7,591,623.

This improvement affords water transportation for a large part of the commodities produced in the valley and is instrumental in reducing freight on railroad shipments from valley points. Lines of the Southern Pacific Railway Company practically parallel the river on each side.

References to former reports are given on page 680 of the Annual Report for 1905.

*Comparative statement of traffic.*

Calendar year.	Tons.	Estimated value.	Passengers.	Calendar year.	Tons.	Estimated value.	Passengers.
1897 .....	186,621	.....	87,960	1902 .....	192,227	.....	95,221
1898 .....	112,154	.....	67,524	1903 .....	236,823	.....	66,510
1899 .....	117,782	.....	50,738	1904 .....	332,130	\$11,260,196	65,947
1900 .....	182,458	.....	47,324	1905 .....	362,255	12,119,596	67,896
1901 .....	191,901	.....	103,971	1906 .....	383,911	7,591,623	41,160

July 1, 1906, balance unexpended .....	\$22,849.64
Refundment of overpayment .....	16.95
Amount appropriated by river and harbor act approved March 2, 1907 .....	60,000.00
	<hr/> 82,866.59
June 30, 1907, amount expended during fiscal year, for maintenance of improvement .....	23,509.95
	<hr/> 59,356.64
July 1, 1907, balance unexpended .....	59,356.64
July 1, 1907, outstanding liabilities .....	5,700.00
	<hr/> 53,656.64
July 1, 1907, balance available .....	53,656.64
Amount (estimated) required for completion of existing project .....	103,500.00
(See Appendix X X 1.)	

2. *Operating and care of lock and dam in Yamhill River, Oregon.*—The Yamhill lock, completed in 1900, is situated on Yamhill River, 8 miles above its mouth and 10 miles below the head of navigation at McMinnville. It was built to afford low-water navigation to McMinnville.

The total traffic through the lock during the year was 2,638.5 tons of freight and 170 passengers. This freight was largely log rafts and pulp wood on barges. The largest year's traffic (1901) was 2,455 tons miscellaneous freight and 1,199 passengers. Steamer traffic has been practically abandoned since 1902, and the reason given is that the steamers formerly employed on the Yamhill find more profitable business on the Willamette. It is claimed by steamboat interests that

the uncertainty of lock operation during the freshet season of winter makes it impossible to compete with the railroad rates.

During the year there was expended in operation of lock, care, and minor repairs \$1,656.14, a part of which was on account of outstanding liabilities incurred the previous year.

The total amount expended to the end of the fiscal year 1907, including the like expenditures of previous years, is \$34,496.11.

(See Appendix X X 2.)

3. *Columbia and lower Willamette rivers below Portland, Oreg.*—Prior to the adoption of any project a temporary and moderate increase in depth was obtained by dredging, at a cost of \$221,780.46.

A project was adopted in 1877 for obtaining a channel 20 feet deep at low water. This was modified in 1891 to provide, mainly by dredging alone, a depth of 25 feet, at an estimated cost of \$772,464, and a State organization entitled the "Port of Portland Commission" was granted permission to assist in the work. On these projects the sum of \$1,080,874.11 was expended over and above the amounts expended by the Port of Portland and those expended by the General Government prior to 1877.

The present project was adopted by the act of June 13, 1902, and provides for a more or less permanent 25-foot channel by means of cross and training dikes and by dredging, at an estimated cost of \$2,971,300. This sum includes the cost of a dredge, estimated at \$175,000. So far no permanent works have been constructed under this project and the only improvement made has been in the way of maintaining the channel by annual dredging. The total expended in this manner under this project to June 30, 1907, is \$405,953.35.

The river and harbor act of March 2, 1907, appropriated \$300,000 for the construction and operation of a dredge. Plans and specifications for this dredge were prepared in the office of the Philadelphia, Pa., district, and details concerning the same will be found in Appendix H 9. The approximate cost of the dredge delivered at Portland, Oreg., completely outfitted for operation, is \$272,500, and the amount expended to June 30, 1907, is \$1,167.32.

The work of the fiscal year consisted in dredging with the U. S. dredge *Ladd* in the lower portion of the estuary and intermittently with the 30-inch dredge of the Port of Portland in the upper reaches. The dredge *Ladd* removed a total of 519,607 cubic yards and the dredge *Columbia* a total of 658,726 cubic yards. The Port of Portland also operated its 30-inch and 20-inch dredges at its own expense when the former was not working under contract with the United States and when the funds at its disposal were sufficient to allow of operations being carried on. The commission reports having removed a total of 435,828 cubic yards.

The betterment of the channel by dredging is very essential pending the appropriation of sufficient funds to construct the permanent works provided for in the project. The dredging of the past year has maintained the depths heretofore realized and there has been no time during the year when a vessel could not safely load to a draft of 24 feet.

Although the dredge *Ladd* is near her end as to state of hull, machinery, etc., it is believed that she can be operated advantageously until such time as the new dredge may become available.

The balance on hand will be expended principally in dredging and dredge construction.

The head of deep-sea navigation for ships crossing the bar at the mouth of the Columbia is at Portland, Oreg., on the Willamette River, 110 miles above the mouth of the Columbia. From the latter place light-draft river boats ascend the Willamette River for 150 miles. From the mouth of the Willamette, by using the State portage road, 12 miles in length, the Columbia and Snake rivers are navigable for light-draft river boats at low water at a point on the Snake River about 473 miles from the mouth of the Columbia.

The ruling depth at the end of the fiscal year between Portland and the sea is about 22 feet at low water. The increase in depth since commencement of improvement is about 8 feet over a good navigable width of channel.

The export commerce using this waterway consists principally of grain and lumber, while the imports are, in a great measure, composed of the products of the oriental countries, also cement, coal, lime, sulphur, etc. The light-draft tonnage consists mostly of dairy, farm, and lumber products, also miscellaneous machinery and mercantile supplies.

The total commerce handled during the calendar year 1906 amounted to 3,532,094 tons, the estimated value of which was \$60,785,631.

References to former reports are given on page 683 of the Annual Report for 1905.

*Comparative statement of traffic.*

Calendar year.	Handled by river vessels.		Handled by seagoing vessels.				Handled by river and seagoing vessels.	
	Quantity.	Estimated value.	Receipts.	Shipments.	Total.	Estimated value.	Quantity.	Estimated value.
	<i>Tons.</i>		<i>Tons.</i>	<i>Tons.</i>	<i>Tons.</i>		<i>Tons.</i>	
1897 .....	1,499,337	.....	47,345	290,412	337,757	.....	1,837,094	.....
1898 .....	1,121,161	.....	27,776	488,818	516,594	.....	1,637,755	.....
1899 .....	1,489,708	.....	36,253	336,134	372,387	.....	1,862,095	.....
1900 .....	1,287,582	.....	32,905	489,385	552,290	.....	1,809,872	.....
1901 .....	1,584,780	.....	29,548	639,736	669,284	.....	2,204,064	.....
1902 .....	1,567,336	.....	145,514	985,912	1,131,426	.....	2,698,762	.....
1903 .....	1,596,220	.....	173,006	659,178	832,184	.....	2,428,404	.....
1904 .....	1,905,451	\$30,775,609	229,833	548,495	778,328	\$27,281,302	2,683,779	\$58,056,911
1905 .....	2,313,153	26,712,339	210,026	736,779	946,805	31,786,607	3,259,958	58,498,946
1906 .....	2,331,121	26,377,640	226,656	974,317	1,200,973	34,407,991	3,532,094	60,785,631

July 1, 1906, balance unexpended .....	\$157,953.26
Receipts from sales .....	347.11
Amount appropriated by river and harbor act approved March 2, 1907 .....	300,000.00

June 30, 1907, amount expended during fiscal year, for maintenance of improvement .....	458,300.37
.....	<sup>a</sup> 72,083.62

July 1, 1907, balance unexpended .....	<sup>b</sup> 386,216.75
July 1, 1907, outstanding liabilities .....	<sup>c</sup> 2,579.40

July 1, 1907, balance available .....	383,637.35
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Amount (estimated) required for completion of existing project .....	2,498,509.93
(See Appendix X X 3.)	

<sup>a</sup> Includes \$1,167.32 on account of construction of dredge.

<sup>b</sup> Includes \$832.63 on account of construction of dredge.

<sup>c</sup> Includes \$79.40 on account of construction of dredge.

4. *Mouth of Columbia River, Oregon and Washington.*—Prior to the construction of a jetty which was commenced in 1885, there were at different periods from one to three channels across the bar, unstable as to depth and position, the depths being usually between 19 and 21 feet, and the positions shifting through nearly 180° of arc between Cape Disappointment and Point Adams.

The first project for improving the entrance was adopted in 1884 and provided for a single jetty on the south side of the entrance, the enrockment to begin at Fort Stevens and to extend in a direction north of west across Clatsop Spit to a point about  $4\frac{1}{2}$  miles from the root at Fort Stevens and 3 miles south of Cape Disappointment. The jetty was to be built of rubblestone of large size, placed upon a foundation course of brush mattresses, and raised to the level of low tide. This project was modified in 1893 to provide for raising the jetty to high-tide level, and for building four groins from 500 to 1,000 feet long on the north side of the jetty.

The jetty as projected in 1884 and modified in 1893 was estimated to cost \$3,710,000, and was completed in 1895 at a cost of less than \$2,000,000. On this latter date a depth of 31 feet was realized, an increase of 11 feet over the depth existing at the time the improvement was commenced. But this depth did not long prevail. A progressive deterioration soon set in. By 1899 the best depths had lessened to 28 feet and the channel had shifted into an unstable position 2 miles north of the 1895 channel. By 1902 the depths had still further deteriorated to 21 feet at low water.

With a view to arresting the shoaling process and securing a stable position for the channel, the district officer submitted a report in 1899 recommending that the 1895 jetty be extended a farther distance of 3 miles. This report was the basis upon which Congress appropriated \$250,000 (act of June 6, 1900) for repairing the jetty tramway and track, pending a report and recommendation by a Board of Engineers.

The report of this Board, which is published in the Annual Report of the Chief of Engineers for 1903, page 2275 et seq., constitutes the project under which work is now being prosecuted. As approved by the Secretary of War March 16, 1903, it provides for extending the 1895 jetty a farther distance of about  $2\frac{1}{2}$  miles and for ultimately building a north jetty if concentration from the northerly headland should be found necessary. The project also provided for a dredge to aid the concentrated current in deepening and maintaining a channel of the requisite depths. The estimated cost, including the equipment of a dredge, was \$3,715,000. The project has been revised as to quantities and cost, as set forth in the Annual Report for 1906, page 758.

Under this project the following appropriations have been made or pledged:

River and harbor act of June 13, 1902	\$500, 000
Sundry civil act of March 3, 1903	1, 000, 000
River and harbor act of March 3, 1905	400, 000
Special act of April 23, 1906	400, 000
Sundry civil act of June 30, 1906	300, 000
River and harbor act of March 2, 1907	750, 244
River and harbor act of March 2, 1907 (pledged and yet to be appropriated)	1, 700, 000
Total	5, 050, 244

The annual survey was made in June, 1907, and shows the following changes from last year's survey:

There is a tendency to shoal in the vicinity of the channel used for two years past and there is no longer any decided depression across the bar at this point as there was a year ago.

To the southwest about 7,000 feet of the bar crest is beginning to yield to the increased scour which the incomplete jetty extension has set up, and within this distance there are four distinct depressions or channels 24, 24½, 25½, and 25½ feet deep at lower low water, respectively, at the shoalest points. The deepest of these channels are 4,000 feet apart and the lesser channels are between these two. These channels, are, however, comparatively narrow as yet, but they will doubtless broaden under the same scouring force that has produced them, and that the four of them will eventually be merged into one broad channel having in the near future a greater depth than has been available for some years is reasonably certain. Whether the present narrow channels are wide enough to make the increased depths practicable for present use has not yet been determined.

Among other changes revealed by the bar survey, the following are the most important.

There has been a scour on the harbor face of Peacock Spit and a fill on the sea face. The sands of Clatsop Spit, north of the jetty, have advanced westward toward the sea the comparatively long distance of nearly 1 mile. There has also been a shoaling immediately south of the exposed portion of the jetty. This shoaling on both sides of the jetty is very satisfactory, as without it the permanence of the enrockment could not be assured.

The dredge *Chinook* has been kept in harbor in charge of watchmen all year. Her boilers are unfit for use and must be replaced before it is safe to again put the dredge in commission. If serviceable now, it is believed she could do very effective work upon the bar crest, as the assistance which the dredge could give would greatly aid the concentrated tidal current in broadening and deepening the channel now in process of formation. As stated above, however, the dredge can not be safely commissioned until new boilers have been installed, the cost of which is estimated at present prices from \$80,000 to \$90,000. An appropriation to equip the dredge with new boilers is urgently recommended.

There has been expended on this work to June 30, 1907, \$4,863,493.55, of which \$1,968,753.14 was under the original project and \$2,894,740.41 under the present approved project.

The amount named in the money statement as a profitable expenditure to June 30, 1909, is the amount authorized under continuing contracts in the act of March 2, 1907, for completing the south jetty, but owing to increased price of labor and material, and also the damage caused to the jetty tramway by the winter storms, it is believed that this amount will not be sufficient and that a supplementary estimate covering the increase in cost may have to be submitted.

For commercial statistics see report on improving "Columbia and lower Willamette rivers below Portland, Oreg."

References to former reports will be found on pages 686-687 of the Annual Report for 1905.

July 1, 1906, balance unexpended-----	\$665, 757. 99
Receipts from sales-----	207. 25
Amount appropriated by river and harbor act approved March 2, 1907-----	750, 244. 00
	<hr/> 1, 416, 209. 24
June 30, 1907, amount expended during fiscal year, for works of improvement-----	702, 404. 60
July 1, 1907, balance unexpended-----	713, 804. 64
July 1, 1907, outstanding liabilities-----	53, 000. 00
July 1, 1907, balance available-----	<hr/> 660, 804. 64
July 1, 1907, amount covered by uncompleted contracts-----	30, 155. 00
Amount( estimated) required for completion of existing project, not including the north jetty-----	<hr/> 1, 700, 000. 00
<hr/>	
{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907-----	
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

(See Appendix X X 4.)

5. *Clatskanie River, Oregon.*—The Clatskanie River rises in the Coast Range and empties into the Columbia River 65 miles below Portland, Oreg. The head of navigation is the town of Clatskanie, 3 miles above the mouth, from which large quantities of lumber and shingles are shipped by water. This stretch of river is tidal with a variation of water level due to tides only of about 5 feet and due to tides and Columbia River freshets 10 feet.

Before improvement the obstructions to navigation were a single shoal with but 2 to 3 feet of water on it near the mouth of the river and a narrow and tortuous channel around two sharp bends.

Under an appropriation of \$13,000 by the river and harbor act of March 3, 1899, the Secretary of War on May 27, 1899, approved a project for dredging this shoal and cutting off two sharp bends by means of cut-off channels. This improvement has been completed and has resulted in giving a depth of 5 feet over the shoalest place and in making the channel to Clatskanie shorter and easier of navigation.

No work has been done the past year and none is needed or contemplated in the near future.

The amount expended to June 30, 1907, was \$12,087.47, of which \$280.10 has been applied to maintenance. The small expenditure during the fiscal year was on account of an examination made to determine the conditions.

The commerce of Clatskanie River consists of sawmill products, farm products, and general supplies. During the calendar year 1906 this commerce aggregated 10,339 tons, valued at approximately \$216,630.

The Astoria and Columbia River Railroad crosses the valley near the town of Clatskanie, but the river does the bulk of the business because it is the cheaper route of transportation.

References to former reports are given on page 688 of the Annual Report for 1905, and page 765 of the Annual Report for 1906.

*Comparative statement of traffic.*

Calendar year.	Tons.	Estimated value.	Passengers.	Calendar year.	Tons.	Estimated value.	Passengers.
1897 .....	112,803	.....	11,545	1902 .....	23,790	.....	1,180
1898 .....	153,257	.....	12,250	1903 .....	25,765	.....	494
1899 .....	68,126	.....	5,210	1904 .....	18,861	\$444,210.00	525
1900 .....	88,622	.....	5,305	1905 .....	16,408	612,970.00	.....
1901 .....	51,967	.....	2,136	1906 .....	10,339	216,630.00	.....

July 1, 1906, balance unexpended..... \$917.48  
 June 30, 1907, amount expended during fiscal year, for maintenance of improvement..... 4.95

July 1, 1907, balance unexpended..... 912.53

(See Appendix XX 5.)

6. *Cowlitz and Lewis rivers, Washington.*—(a) *Cowlitz River.*—The Cowlitz River rises in the Cascade Range and flows in a southerly direction and empties into the Columbia 64 miles from the sea. The extreme head of navigation is about 10 miles above Toledo, or 46 miles above the mouth. For a stretch of 36 miles downstream from this point the stream is tortuous and nontidal, abounds in numerous sand and gravel bars, is frequently obstructed by snags, and is navigable at medium and the lower stages by small light-draft boats only. On this portion of the river a single boat makes three trips weekly each way.

The lower 9 miles of the river is tidal, with a rise in tide of zero at the upper end to 4 feet at the mouth. This portion of the river is also narrow and tortuous, but has a better ruling depth than the nontidal section. As in the upper part of the river, the lower 9 miles is obstructed by sand and gravel bars and snags. The river is liable to freshets 22 feet or more in height during the winter season.

Kelso, containing 1,500 inhabitants, and located  $4\frac{1}{2}$  miles above the mouth of the river, is the principal business town of the valley. It is the center of a large lumber and shingle manufacturing industry, and the point at which a large number of log and pile rafts are made up for towage to Portland and other points. During the calendar year 1906 1,260,600 feet B. M. lumber, 184,357,000 feet B. M. logs, 1,076,000 feet of piles, and 7,600 cords of wood were transported by water, the value of which was upward of \$1,240,000. In addition to this, over 20,000 tons of general merchandise and produce was handled, valued at approximately \$1,920,000.

The original project for the river's improvement was adopted in 1880, and was designed to aid navigation by the deepening of sand bars and the removal of snags at an estimated cost of \$5,000 the first year and \$2,000 for succeeding years. This project is still in force.

The appropriations made for this work have been expended from time to time in snagging and blasting out obstructions and in later years in opening some of the more troublesome bars by dredging. The expenditures to the close of the fiscal year 1907 amounted to \$39,758.25, of which sum \$34,758.25 may be regarded as applied to maintenance.

The expenditures during the fiscal year were applied to snagging and dredging and in constructing a new hull for the dredge. The

balance on hand will be expended in further dredging and snagging as may be necessary.

References to former reports are given on page 689 of the Annual Report for 1905.

*Comparative statement of traffic.*

Calendar year.	Tons.	Estimated value.	Passengers.	Calendar year.	Tons.	Estimated value.	Passengers.
1897.....	17,582	.....	.....	1902.....	15,932	.....	.....
1898.....	16,210	.....	.....	1903.....	41,515	.....	.....
1899.....	26,511	.....	.....	1904.....	26,120	\$1,069,020	6,875
1900.....	17,279	.....	.....	1905.....	46,646	1,494,260	6,000
1901.....	14,211	.....	.....	1906.....	56,109	2,055,460	1,117

This statement does not include 184,357,000 feet B. M. (368,714 tons) of logs sent down this stream in 1906, having an estimated value of \$1,106,142.

July 1, 1906, balance unexpended..... \$1,676. 78

Amount allotted from appropriation by river and harbor act approved

March 2, 1907..... 12,500. 00

14,176. 78

June 30, 1907, amount expended during fiscal year, for maintenance of improvement..... 1,285. 03

July 1, 1907, balance unexpended..... 12,891. 75

(b) *Lewis River*.—The Lewis River rises in the Cascade Range, flows into the Columbia River from the north about 14 miles below the mouth of the Willamette River, or 25 miles from Portland, Oreg. It is tidal in its lower reaches and is affected by the backwater from the Columbia during freshet times in that river. The river forks about 3½ miles from the mouth. These forks are known as the East and North forks.

Up to the time of the adoption of the present and original project about 4 feet could be carried at normal stage to the forks, about 2 feet on the East Fork to La Center, 7 miles from the mouth, at a stage of 2 feet 10 inches above normal and about 1 foot at normal stage to Woodland on the North Fork, 7½ miles from the mouth. The channel at that time was obstructed by trees, snags, and occasional shoals, but the river was navigated by light-draft vessels during the higher stages to La Center and to Woodland.

The original project (see Annual Report of the Chief of Engineers for 1897, p. 3475) contemplated the removal of snags and obstructions, dike and dam work, and dredging, with a view to obtaining 6 feet in the main river to the forks and 4 feet thence to La Center on the East Fork; estimated cost, \$20,460. The object was to furnish an improved channel during the lower stages of water.

This project contemplated only the improvement of the East Fork, but the river and harbor acts of June 13, 1902, and March 2, 1907, included the North Fork, for which no estimate of cost has been made.

The work accomplished on the project has consisted in deepening the channel by dredging where necessary and removal of some of the obstructions to a point 225 feet above the flume on the East Fork and to Woodland on the North Fork.

The work done on the river during the fiscal year consisted entirely of snagging on the North Fork as far as Hayes Bend, 12½ miles above the mouth, and on the East Fork to La Center, 7 miles above the



mouth. The work was done during December, January, and March, and the river was left in good condition.

The expenditures made also include some work done on the new dredge at the Government moorings.

The maximum draft that could be carried at normal stages on June 30, 1907, is as follows: From the mouth to the forks, about 4 feet; East Fork to 225 feet above the flume near Kinder rock, 1 foot; North Fork to Woodland, 1 foot.

The usual variations of level of water surface, due to tides, are: At the mouth, 2 feet; at La Center, 1½ feet; at Woodland the tide has no effect. The freshets vary from 15 to 20 feet in height, except near the mouth, where the water spreads out over a large area.

The available balance will be required for dredging and snagging operations.

Except for the town of Woodland, which is on the Northern Pacific Railroad, the river is the only means of transporting the products of the valley to the Portland market. The commerce consists principally of lumber and farm products and general supplies. During the calendar year 1906 the commerce amounted to 16,684 tons, not including large quantities of logs floated down the stream. The estimated value is approximately \$950,760.

The amount expended on this work up to the close of the fiscal year 1907 was \$18,275.07.

References to former reports are given on pages 690-691 of the Annual Report for 1905.

*Comparative statement of traffic.*

Calendar year.	Tons.	Estimated value.	Passengers.	Calendar year.	Tons.	Estimated value.	Passengers.
1897 .....	3,881	.....	15,306	1902 .....	13,881	.....	13,098
1898 .....	6,303	.....	15,938	1903 .....	29,033	.....	13,058
1899 .....	6,549	.....	12,351	1904 .....	27,245	\$834,492	12,885
1900 .....	12,638	.....	14,129	1905 .....	26,554	1,067,733	29,026
1901 .....	17,277	.....	15,582	1906 .....	19,024	960,120	16,614

This statement does not include 60,528,000 feet B. M. (121,056 tons) of logs sent down this stream in 1906, having an estimated value of \$363,168.

July 1, 1906, balance unexpended..... \$4,937. 18  
Amount allotted from appropriation by river and harbor act approved  
March 2, 1907..... 2,500. 00

7,437. 18

June 30, 1907, amount expended during fiscal year, for maintenance  
of improvement ..... 2,862. 25

July 1, 1907, balance unexpended..... 4,574. 93

CONSOLIDATED.

July 1, 1906, balance unexpended..... \$6,613. 96  
Amount appropriated by river and harbor act approved March 2, 1907..... 15,000. 00

21,613. 96

June 30, 1907, amount expended during fiscal year, for maintenance  
of improvement ..... 4,147. 28

July 1, 1907, balance unexpended..... 17,466. 68

(See Appendix X X 6.)

7. *Grays River, Washington.*—Grays River is a tributary of the Columbia, emptying into Grays Bay nearly opposite Astoria, Oreg. It has an available depth over the entrance of about 3 feet at low water and a tidal range of from 5 to 8 feet. It has been navigated by small boats for a great many years for a distance of about 8 miles above its mouth. The principal navigation is the towing of logs. The Willamette Pulp and Paper Company, one of the largest operators, estimates that from September 1, 1905, to September 1, 1906, 27,000,000 feet of logs, valued at \$250,000, was towed out of this stream. In addition to the log towage there is one small boat of about 75 tons burden operating daily between Astoria and points on Grays River, carrying mail and passengers and an average of about 5 tons of general merchandise and farm produce on each trip. No improvement by the General Government has ever been made on this river.

The river and harbor act of September 19, 1890, authorized an examination of the river with a view to removing obstructing logs, snags, and overhanging trees, and a favorable report was rendered. Upon the basis of this preliminary report the Board of Engineers for Rivers and Harbors on October 13, 1906, submitted a project for the removal of logs, stumps, and overhanging trees, and clearing the channel up to the present head of navigation at Walkers Landing. This project was adopted by act of March 2, 1907, and an appropriation of \$2,500 was made for the work.

No operations have been carried on during the fiscal year, and no expenditures have been made, as the available plant has been in use at other points. It is proposed to do the work during the present season.

Amount appropriated by river and harbor act approved March 2, 1907_	\$2,500.00
July 1, 1907, balance unexpended_	2,500.00

(See Appendix X X 7.)

8. *Gauging waters of Columbia River, Oregon.*—The object of this gauging is to obtain data for use in connection with the improvement of the river and to supply information to persons interested in its navigation.

The self-registering gauge was established at Astoria in November, 1888, where it was kept in operation up to August, 1899, and then moved to Fort Stevens, where it could be more economically maintained. Daily bulletins have been exhibited for the benefit of shipping interests. A river gauge was also established at the mouth of the Willamette River and daily records of the readings kept. In view of the benefit to commerce, the maintenance of these gauges is considered a worthy object.

The amount expended on this work up to June 30, 1907, was \$8,386.60.

July 1, 1906, balance unexpended_	\$1,873.44
June 30, 1907, amount expended during fiscal year, for maintenance of improvement_	260.04

July 1, 1907, balance unexpended_	1,613.40
July 1, 1907, outstanding liabilities_	21.00

July 1, 1907, balance available_	1,592.40
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(See Appendix X X 8.)

## EXAMINATION AND SURVEY MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT APPROVED MARCH 3, 1905.

Reports dated April 4, 1905, and October 6, 1906, required by the river and harbor act of March 3, 1905, on preliminary examination and survey of *Astoria Harbor, Oregon*, were submitted by the district officer and were reviewed by the Board of Engineers for Rivers and Harbors pursuant to law. They were transmitted to Congress and printed in House Document No. 216, Fifth-ninth Congress, second session. The locality is not deemed worthy of improvement by the General Government at the present time.

## IMPROVEMENT OF CERTAIN RIVERS AND HARBORS IN WASHINGTON.

This district was in the charge of Maj. H. M. Chittenden, Corps of Engineers, with Capt. F. A. Pope, Corps of Engineers, under his immediate orders to August 15, 1906. Division engineer, Col. W. H. Heuer, Corps of Engineers, to March 2, 1907, and Lieut. Col. S. W. Roessler, Corps of Engineers, since June 3, 1907.

1. *Willapa River and Harbor, Washington*.—Willapa Harbor connects with the Pacific Ocean in the extreme southwestern part of the State of Washington. Willapa River flows into the bay at its eastern extremity, about 10 miles from the sea entrance to the harbor.

South Bend, near the mouth of the river, the terminus of a branch line of the Northern Pacific, and Raymond, about 3 miles above South Bend, are the principal towns in that locality. Willapa is a small town 10 miles above South Bend. North River is a stream flowing into the bay from the north, and the Nasel River is a sort of arm making off southeasterly from the southeast part of the bay proper.

Originally shoals existed in the river below Willapa, and there was a log jam in North River.

The original and existing project contemplates dredging 100 feet wide and to a depth of 8 feet at low water through the reef just below Willapa, and the closing of side sloughs near South Bend by means of dikes, with the object of increasing channel depths by scour. Project adopted by act of July 13, 1892.

The project was modified by act of March 2, 1907, to provide for dredging a channel 150 feet wide and 12 feet deep at mean lower low water through the shoals between South Bend and Raymond, at an estimated cost of \$25,000.

Under acts of August 18, 1894, and March 3, 1899, removal of the log jam in North River was authorized.

The estimated cost is \$61,350 for the entire project.

The amount expended on original and existing project to close of fiscal year ending June 30, 1907, was \$36,170.56, of which \$4,040.20 was applied to the maintenance of dikes and for inspection of obstructions to navigation.

The best channel depth at low water is now about 16 feet to South Bend, and to Raymond and Willapa about 9 feet.

Advertisement for proposals for dredging Willapa River were issued June 15; bids to be opened July 15, 1907.

The extreme variation of water levels is 14 feet, and the mean variation is 9 feet.

The North and Nasel rivers are navigable only for small boats of light draft for a comparatively short distance above their mouths, and this distance is extremely variable with the tides. The principal business on these rivers is the rafting and floating of logs. The log and lumber business on Willapa Bay and tributary streams is by far the most important part of the water traffic.

*Exports and imports.*

Calendar year.	Tons.	Value.	Calendar year.	Tons.	Value.
1898.....	32,399	\$374,050	1903.....	74,475	\$446,800
1899.....	51,150	755,682	1904.....	73,808	389,377
1900.....	42,090	266,080	1905.....	76,713	456,213
1901.....	39,538	229,686	1906.....	116,717	1,220,484
1902.....	51,909	402,050			

The direct effect on freight rates of the work done is not known definitely.

Detailed reports on this work are given in Annual Reports of the Chief of Engineers for 1893, pages 3402 to 3408, and for 1895, pages 3399 to 3405. Maps of the locality are published with Annual Report of the Chief of Engineers for 1891, pages 3264 and 3268.

Reports of examinations and surveys are referred to in the Annual Report of the Chief of Engineers for 1904, page 687.

Reference to reports on examination and survey ordered by the river and harbor act of March 3, 1905, will be found on page 787, Annual Report for 1906.

The full amount for improvement as heretofore authorized by Congress has been appropriated.

By the act of June 13, 1902, the balance on hand to the credit of this improvement may be used in snagging and otherwise improving North and Nasel rivers.

July 1, 1906, balance unexpended.....	\$1,183.96
Amount appropriated by river and harbor act approved March 2, 1907.....	25,000.00
	26,183.96
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	1,004.52
July 1, 1907, balance unexpended.....	25,179.44
July 1, 1907, outstanding liabilities.....	96.70
July 1, 1907, balance available.....	25,082.74

(See Appendix Y Y 1.)

2. *Grays Harbor and bar entrance, Washington.*—Grays Harbor is a large bay in the southwestern part of the State of Washington, connecting with the Pacific Ocean. It has a total length from east to west of 17 miles, and its greatest breadth north and south is 14 miles.

A large part of the bay is occupied by tide flats, bare at low water. At low tide the area covered by water is estimated at 30.6 square miles, or less than one-third of the total area. There are two main channels crossing the bay from east to west. The north channel is the principal one, and this is being improved under a special appropriation. A short distance within the harbor entrance are large areas affording anchorages for deep-draft vessels.

The harbor entrance is between two low sandy peninsulas, which are about 12,500 feet apart, measured between high-tide lines.

Through this entrance there is a channel having a maximum depth of 100 feet or more. A single broad waterway extends for more than 2 miles out to sea from the entrance, with depths gradually diminishing to 30 feet. At the outer end of this deep waterway lies a bar convex to the sea and extending each way to the sand spits on the two sides of the harbor throat.

Across the bar there was originally no good permanent channel, but there were several variable, shifting channels having depths of about 12 or 13 feet. The general average width of the bar between the inner and outer 18-foot curves was one-half mile.

The original and existing project, adopted by Congress June 3, 1896, provides for the control of the tidal currents by means of a single jetty extending out to sea from the point on the south side of the harbor throat a distance of about  $3\frac{1}{2}$  miles, with a view to improving and maintaining the channel over the bar by scour. The jetty is to be of rubblestone, built above high-tide level. This project contemplates a depth of 24 feet at mean low water.

The estimated cost was \$1,000,000. The act making the first appropriation for this work authorized the making of a continuing contract or contracts. In accordance with this authority a contract for the entire work was entered into after due advertisement. This contract was approved by the Chief of Engineers February 23, 1898. Work under it commenced in March, 1898, and terminated September 15, 1902. No construction work on the south jetty has been done since.

The project was enlarged by the river and harbor act of March 2, 1907, to cover the construction of a jetty on the north side of the harbor throat, extending out to sea 9,000 feet from the ocean high-water line, at estimated cost of \$600,000. The said act appropriated \$200,000 and authorized continuing contracts for completing the project in the additional sum of \$400,000, yet to be appropriated. This project is printed in River and Harbor Committee Document No. 2, Fifty-ninth Congress, second session.

The amount expended to June 30, 1907, was \$1,006,779.24, of which \$6,235.72 was for maintenance and surveys. The sum of \$3.60 was received from sales of contact prints.

A survey of the bar was made during August and September, 1906.

Preliminary surveys for the north jetty were made, and preparation of plans and action to secure right of way commenced.

The work of maintenance consisted only in care of the property.

The bar channel has shown variations in depth and position during the year. The maximum draft that could be carried June 30, 1907, at mean low water over the shoalest part of the channel was about 18 feet.

The extreme variation of water levels in the outer portion of the harbor is 16.5 feet, while the mean variation is 8.4 feet.

The commerce benefited by the work consists at present principally of exportation of lumber carried in sail vessels and steam schooners. This is a large and important business.

*Exports and imports.*

Calendar year.	Tons.	Value.	Calendar year.	Tons.	Value.
1898.....	168,468	\$1,252,089	1903.....	458,268	\$4,073,833
1899.....	265,918	1,979,998	1904.....	495,495	4,200,784
1900.....	259,692	2,077,037	1905.....	579,759	5,552,166
1901.....	299,607	1,877,800	1906.....	614,854	7,735,954
1902.....	527,047	3,601,163			

The direct effect on freight rates of the work done is not known, but there are now two companies engaged in the business of towing vessels in and out over the bar, which indicates greater business and greater competition, as the business was formerly all in the hands of one towboat company.

A report of the original survey, giving a full description of this work, with plan, is published in the Annual Report of the Chief of Engineers for 1895, pages 3517 to 3528, and in Senate Executive Document No. 112, Forty-seventh Congress, first session.

The plans for this work and proposed modification of same are referred to in Annual Report of the Chief of Engineers for 1905, page 694.

The full amount originally authorized by Congress for a south jetty—\$1,000,000—has been appropriated.

July 1, 1906, balance unexpended.....	\$28,764.21
Amount appropriated by river and harbor act approved March 2, 1907.....	200,000.00
Received from sales.....	3.60

228,767.81

June 30, 1907, amount expended during fiscal year:

For works of improvement.....	\$1,678.20
For maintenance of improvement.....	3,865.25
	5,543.45

July 1, 1907, balance unexpended.....	223,224.36
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July 1, 1907, outstanding liabilities.....	350.00
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July 1, 1907, balance available.....	222,874.36
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Amount (estimated) required for completion of existing project.....	400,000.00
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{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907.....	400,000.00
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

(See Appendix Y Y 2.)

3. *Grays Harbor (inner portion) between Aberdeen and the entrance to said harbor, and Chehalis River, Washington.*—There are two main channels traversing the inner or eastern part of Grays Harbor from east to west—the North and South channels. There was also formerly a Middle channel connecting the North and South channels. The South channel is shoal and is but little used. The North channel is used by all ocean-going vessels entering the harbor. There are two shoals in the North channel, one about  $2\frac{1}{2}$  miles below Hoquiam and one between Hoquiam and Aberdeen. The ruling depth over these shoals was 8 feet at mean low water. The channel widths were ample.

Two middle dikes and a protecting sill, with an aggregate length of 13,986 feet, had been constructed in the inner harbor, and six high-tide dikes, with an aggregate length of 1,476 feet, had been constructed in the Chehalis River. The depth of water over the shoals in the inner harbor was increased about 2 feet and over the shoals in the Chehalis River from  $2\frac{1}{2}$  to 7 feet, but these depths were not permanent.

The Chehalis River is in the southwestern part of Washington. It has a westerly course and empties into Grays Harbor Bay at its eastern extremity.

From the mouth to Montesano, 15 miles, there is about 10 feet of water at high tide. From Montesano to Elma, 16 miles, there is generally sufficient water for light-draft boats. There is practically no navigation above Elma and no regular boats go above Montesano. The river is used extensively for floating saw logs.

The original project for the inner harbor, adopted by Congress July 13, 1892, provided for the construction of pile, brush, and stone dikes to partly close up the South and Middle channels and concentrate the flow of water in the North channel, thereby increasing the depth of water by scour. The shoals above and below Hoquiam were to be dredged to a depth of 16 feet at half tide.

The amount expended prior to operations under existing project was \$93,999.06.

The original and present project for Chehalis River, adopted by Congress August 2, 1882, contemplates the removal of snags and other obstructions which may accumulate in the portion of the river regularly used by boats. The estimated cost is indefinite.

Under the project approved by the Department November 10, 1902, and modified by Board of Engineer officers on December 4, 1903, a channel about 100 feet wide and 15 feet deep at low water was dredged through the shoals below Aberdeen, the dikes were put in repair, and snags and obstructions were removed from the Chehalis River.

The project was modified by the river and harbor act of March 2, 1907, so as to provide for a channel 200 feet wide and 18 feet deep at mean lower low water from Cosmopolis to deep water below Hoquiam, removing snags from the Chehalis River, at an estimated cost of \$187,500. This plan is printed in House Document No. 507, Fifty-ninth Congress, first session.

To June 30, 1907, \$56,550.77 has been expended under the above project for Grays Harbor, inner portion, of which \$19,997.21 was applied to maintenance of dikes and for surveys.

No dredging has been done with funds available on account of the excessive price asked by contractors. Bids were invited three times and each time rejected.

Advertisements for proposals for dredging under the revised project were issued June 15, 1907; bids to be opened July 15, 1907.

Snagging operations were carried on in the Chehalis River during July and August, 1906.

The maximum draft that could be carried June 30, 1907, over the shoals below Aberdeen at low water was about 11 feet.

The maximum draft that could be carried June 30, 1907, at mean low water at Montesano was about  $5\frac{1}{2}$  feet.

The tidal variation is 7 feet in the inner harbor and 5 feet in the Chehalis River. The amount expended to June 30, 1907, was \$150,549.83, of which \$37,415.45 was for maintenance.

The commerce benefited by this improvement consists very largely of floating and towing logs and carrying lumber in sailing vessels and steam schooners.

*Exports and imports.*

Calendar year.	Tons.	Value.	Calendar year.	Tons.	Value.
1898.....	2, 730	\$298, 610	1903.....	4, 972	\$139, 15
1899.....	2, 232	352, 316	1904.....	5, 637	248, 825
1900.....	4, 376	132, 157	1905.....	17, 195	650, 428
1901.....	5, 706	200, 264	1906.....	11, 567	773, 574
1902.....	3, 529	157, 532			

No definite information of reduction of freight rates on account of the improvement has been received.

Report of examination and survey of the inner harbor and the Chehalis River, with maps, was published in the Annual Report of the Chief of Engineers for 1891, pages 3297 to 3305.

Other reports are referred to in Report of the Chief of Engineers for 1904, page 690.

Reference to reports on an examination and survey authorized by the river and harbor act of March 3, 1905, will be found on page 787, Annual Report for 1906.

A recent examination of the dredged channel between Aberdeen and Hoquiam shows marked deterioration during the past year, due, it is thought, to debris brought down from the various tributaries by the freshets caused by logging operations.

It is proposed to apply the balance available to snagging in the Chehalis River, repairing dikes, and to dredging.

July 1, 1906, balance unexpended..... \$25, 675. 96  
Amount appropriated by river and harbor act approved March 2, 1907..... 177, 000. 00

202, 675. 96

June 30, 1907, amount expended during fiscal year, for maintenance  
of improvement ..... 2, 225. 79

July 1, 1907, balance unexpended..... 200, 450. 17  
July 1, 1907, outstanding liabilities..... 484. 50

July 1, 1907, balance available..... 199, 965. 67

(See Appendix Y Y 3.)

4. *Puget Sound and its tributary waters, Washington.*—Most of the channels of Puget Sound proper have ample depths for purposes of navigation, but the extensive lumber and fishing industries in these waters render it very important to maintain a general supervision over the navigable channels, to regulate the construction of fish traps, log booms, and other structures incident to these important industries, and to prevent obstructions which are detrimental to general naviga-



tion interests. A number of streams and rivers tributary to Puget Sound are of great value to boat navigation and for logging purposes so far as depth and width are concerned, but they are all liable to be obstructed by the débris generally found in streams flowing through a heavily wooded country.

All these streams are used for floating logs and shingle bolts to a greater or less extent, and for towing log rafts, and the timber naturally constitutes the main part of the commerce. The distance upstream to which boats run is extremely variable, depending on the stage of water and tide. Steamboat navigation on the Skagit does not extend above Sedro Woolley, a distance of 25 miles, except at high stages. On the Stilaguamish boats do not go above Florence, 6 miles from the mouth. The Snohomish is navigable for river boats to the Forks, 22 miles, and the lower portions of its tributaries, the Snoqualmie and Skykomish, are navigable at high stages. On the Duwamish small boats go as far as the junction of the White and Black rivers, about 12 miles from the mouth. Under favorable conditions they can go several miles up the White. In case of each river, the distance to which steamboat navigation actually extends is generally less and the distance over which towing and floating of logs extends is greater than the distances above named. None of these streams is closed in winter by ice. All streams are affected by the tidal variation in Puget Sound, which is large and extremely irregular.

Formerly works of improvement were carried on under specific appropriations, but since the act of June 13, 1902, appropriations have been made in the present general and comprehensive form, except in cases of large local works. This method operates greatly to the advantage and economy of the work.

The amount expended to June 30, 1907, was \$266,354.40.

The sum of \$160.15 was received from sales of condemned property and contact prints.

The snag boat was in operation from November 30, 1906, to June 30, 1907. The streams worked on were the Skagit, main river and North Fork, Puyallup, Stilaguamish, Nooksak, and Snohomish rivers, Swinomish and Ebey sloughs and Oak Harbor.

The snag boat was laid up at the end of the fiscal year and will be given a thorough overhauling.

The act of March 2, 1907, provided for the removal of the rock in the entrance to Roche Harbor at a cost not to exceed \$30,000. A proposal has been accepted for doing this work at a cost of \$23,460.

The act of March 2, 1907, appropriated \$100,000 for a dredge for the joint use of the Oregon and Washington districts. Plans for the dredge are being prepared (see p. 758 of this report).

The water traffic on Puget Sound and its tributary waters is very large and rapidly growing. It includes vessels of about every type and size in use throughout the world, but it is quite impracticable to give in the form of concise statistics a condensed statement of the amount and value of the commerce more or less directly benefited by work under this appropriation. Statistics have been compiled only for the tributary streams on which the snag boat has mostly worked.

*Exports and imports.*

Calendar year.	Tons.	Value.	Calendar year.	Tons.	Value.
1898.....	12, 676	\$539, 406	1903.....	94, 274	\$3, 193, 458
1899.....	13, 500	577, 586	1904.....	92, 465	1, 790, 823
1900.....	35, 066	1, 324, 926	1905.....	86, 412	1, 817, 048
1901.....	30, 155	1, 499, 420	1906.....	167, 197	1, 898, 057
1902.....	61, 794	2, 324, 980			

No definite information relative to effect of the work on freight rates is available, but the increasing number of vessels engaged indicates greater competition.

Reports of examinations and surveys of the rivers of Puget Sound are referred to in Annual Report of the Chief of Engineers for 1904, page 692.

Reference to reports on the examination and survey of the Duwamish River authorized by the river and harbor act of March 3, 1905, will be found on page 787, Annual Report for 1906.

The snag boat is in need of a thorough overhauling. It was built in 1882, the hull renewed in 1896, and it is now in a condition that practically requires another renewal of the hull. It is not sufficiently seaworthy to be safe in ordinary rough weather in the Sound.

There is a considerable amount of miscellaneous work in the district that is paid from this appropriation, such as investigation of harbor lines, bridges, obstructions, occasional surveys, gauge readings, etc.

## GENERAL IMPROVEMENT.

July 1, 1906, balance unexpended.....	\$3, 648. 30
Amount appropriated by river and harbor act approved March 2, 1907.....	75, 000. 00
Received from sales.....	160. 15
	78, 808. 45
June 30, 1907, amount expended during fiscal year, for works of improvement.....	5, 369. 52
July 1, 1907, balance unexpended.....	73, 438. 93
July 1, 1907, outstanding liabilities.....	4, 000. 07
July 1, 1907, balance available.....	69, 438. 86

## EMERGENCIES IN RIVERS AND HARBORS.

Amount allotted from appropriation for emergencies, act of March 3, 1905.....	\$4, 500. 00
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	4, 133. 18
July 1, 1907, balance unexpended.....	366. 82
July 1, 1907, outstanding liabilities.....	366. 82

(See Appendix Y Y 4.)

5. *Inspection of fish traps, etc., Puget Sound, Washington.*—The fishing industry on Puget Sound has rapidly developed during the

past few years, and it has now reached very large proportions. Until four years ago the fish traps were placed with little or no regard to the established aids to navigation or to the laws relative to structures in navigable waters, but during the year 1904 the fishing companies were brought to the adoption of a different policy. Since 1904 this work has been done under allotments from the appropriation for "Examinations, Surveys, and Contingencies of Rivers and Harbors."

Under these allotments a tug was hired for the inspection of fish traps from time to time as necessary. A tug was so engaged for two months during the year.

As a general rule all the fish-trap owners and fishing companies now readily conform to the requirements that have been imposed for the safety of navigation, and the Federal supervision of the traps in the interests of navigation is recognized locally as most necessary and beneficial to the public interests.

The total amount expended to June 30, 1907, was \$17,754.90, of which \$3,655.47 was expended during the year.

Form of permit and rules relative to lights and fog signals were published in the Annual Report of the Chief of Engineers for 1905, pages 2558-2560.

To carry out more effectively and economically the inspection of fish traps and other obstructions to navigation an inspection boat is being constructed for exclusive use in this work.

(See Appendix Y Y 5.)

6. *Harbor at Olympia, Wash.*—Olympia is situated at the extreme southern point of Puget Sound at the head of Budd Inlet. The upper end of this inlet is shoal. Shoal water extends northward from the Fourth Street Bridge for a distance of 8,750 feet to a depth of 12 feet at mean lower low water in Budd Inlet. Originally nothing but shallow-draft boats could reach the wharves near Fourth Street Bridge, and those only at high tide.

The original and existing project, adopted by Congress by act of July 13, 1892, contemplates dredging a channel 250 feet wide and 12 feet deep at the mean of the lower low waters from the vicinity of the Fourth Street Bridge to deep water in Budd Inlet.

Near its inner end the channel has been widened to 500 feet, so as to provide a turning basin for boats using it. The estimated cost is \$147,000.

The amount expended to June 30, 1907, was \$139,722.57, of which \$843.34 was for maintenance.

The dredging of the channel and basin was completed in accordance with the project, under contract. The maximum draft that could be carried through the channel and basin on June 30, 1907, at low water was 12 feet. The tidal variation is about 20 feet.

The commerce of the harbor is of general character and is carried on by ocean-going sailing vessels engaged in the lumber trade and by a variety of the smaller classes of boats plying between the ports of Puget Sound. Sufficient depth for seagoing vessels has not yet been secured in the dredged channel and basin, though vessels of the deepest draft can go as far as the entrance of the dredged channel, and sailing vessels carrying lumber now reach wharves near the entrance

to the dredged channel at high tide and lie in a dredged basin while loading.

*Exports and imports.*

Calendar year.	Tons.	Value.	Calendar year.	Tons.	Value.
1898.....	52,335	\$1,203,226	1903.....	40,333	\$341,635
1899.....	42,694	1,173,684	1904.....	20,152	356,450
1900.....	35,466	848,703	1905.....	62,804	2,069,289
1901.....	44,559	951,435	1906.....	82,024	2,363,433
1902 <sup>a</sup> .....					

<sup>a</sup> Not obtainable.

No definite information as to the effect on freight rates of the work done is available.

Description and map are published in Annual Report of the Chief of Engineers for 1900, pages 4481 to 4483.

Reports on examination and survey of Olympia Harbor are referred to in Annual Report of the Chief of Engineers for 1904, page 694.

Reference to reports on examination and survey authorized by the river and harbor act of March 3, 1905, will be found on page 787, Annual Report for 1906.

The full amount for this improvement as heretofore authorized by Congress has been appropriated.

July 1, 1906, balance unexpended.....	\$7,282.37
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	4.94
July 1, 1907, balance unexpended.....	7,277.43
July 1, 1907, outstanding liabilities.....	6.44
July 1, 1907, balance available.....	7,270.99

(See Appendix Y Y 6.)

7. *Tacoma Harbor, Washington.*—At the southern end of the harbor are extensive tide flats which are bare at low water. Outside of these tide flats the depth increases very rapidly up to depths of 200 feet or more, reaching depths as great as 600 feet at the mouth of the bay, about 3 miles distant from the low-water line at its southern end. The principal water front of Tacoma is along the southwestern shore of the bay. Harbor lines have been established around the south end of the bay and along its western side. In order to facilitate commerce several waterways extending into the flats or tidelands have been laid out. One of these is known as the City or West waterway. The harbor of Tacoma may be considered to embrace all of Commencement Bay, including the waterways mentioned.

The original and existing project for improvement of the City waterway, adopted by Congress by the act of June 13, 1902, contemplates dredging in the City waterway from deep water in Commencement Bay to Eleventh street to a depth of 25 feet, from Eleventh street to Fourteenth street to a depth of 18 feet, and from Fourteenth street to the south end of waterway to a depth of 15 feet at extreme low water. The dredging was done under a continuing contract.

The amount expended to June 30, 1907, was \$158,188.09, of which \$8,034.01 was for maintenance, inspections, and surveys.

The City waterway has been completed according to the project and the prescribed depths could therefore be carried for the whole length and width of the waterway on June 30, 1906.

The extreme tidal variation is some 18 feet; mean variation, 14.5 feet.

The act of March 3, 1905, provided for improvement of the Puyallup waterway by dredging a channel 500 feet in width and 3,650 feet in length from its northern end, and to a depth of 28 feet at extreme low water, in accordance with the report submitted in House Document No. 520, Fifty-eighth Congress, second session, at an estimated cost of \$240,000. The same act appropriated \$40,000, and authorized continuing contracts for completing the project in the sum of \$200,000, of which \$40,000 is yet to be appropriated. The act requires that certain portions of the necessary work shall be done without expense to the United States, and that provision for permanent maintenance of the project without expense to the Government shall be made.

The conditions named in the said act have been complied with, agreements and bonds approved by the Secretary of War, and proposals for doing the work will be invited at an early date.

The commerce to be benefited by this improvement is of a large and extremely varied character, including that carried on by Sound and river types of boats, as well as that of the largest steam and sailing vessels. A very important item is the export of grain, in which the port of Tacoma exceeds all other ports on Puget Sound.

*Exports and imports.*

Calendar year.	Tons.	Value.
1903 .....	1, 715, 085	\$58, 153, 845
1904 .....	1, 561, 074	53, 726, 772
1905 .....	1, 844, 338	65, 613, 183
1906 .....	1, 120, 070	4, 823, 383

No definite information is available as to the effect of the improvement on freight rates.

Report of a survey of "mouth of Puyallup River, Washington," is published in Annual Report of the Chief of Engineers, 1898, pages 3098-3102.

Description of proposed work is published in Annual Report of the Chief of Engineers for 1901, pages 3593-3602.

Report on examination and survey is published in House Document No. 76, Fifty-sixth Congress, second session.

Report of examination and survey of the Puyallup and other waterways is referred to in the Report of the Chief of Engineers for 1904, page 695.

It is proposed to apply the available funds and additional appropriation asked for to maintenance of existing waterways and dredging Puyallup waterway as contemplated in the adopted project.

July 1, 1906, balance unexpended.....	\$221, 136. 12
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	4, 324. 21
July 1, 1907, balance unexpended.....	216, 811. 91
July 1, 1907, outstanding liabilities.....	733. 50
July 1, 1907, balance available.....	216, 078. 41
Amount (estimated) required for completion of existing project....	40, 000. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unex- pended July 1, 1907.....	40, 000. 00
Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

(See Appendix Y Y 7.)

8. *Waterway connecting Puget Sound with Lakes Union and Washington, Washington.*—Lakes Union and Washington are bodies of fresh water near Puget Sound, in the immediate vicinity of the city of Seattle. Lake Union is entirely within the city limits. The proposed improvement originally contemplated a ship canal connecting both lakes with the Sound. There is no navigable connection at present.

The first official report upon the project was by Gen. Barton S. Alexander, Corps of Engineers, in 1871. The first Congressional action was in the act of September 19, 1890, which contained an item directing the appointment of a Board of three officers of the Corps of Engineers to select and survey the most feasible location and estimate the expense of constructing a ship canal to connect the waters of Lakes Union, Washington, and Samamish with Puget Sound, and appropriating \$10,000 for the necessary expenses.

The act of August 18, 1894, making the first appropriation for the work, contained the following provision: "That no part of said amount shall be expended on the improvement of the waterway connecting the waters of Puget Sound with Lakes Union and Washington until the entire right of way and a release from all liability to adjacent property owners have been secured to the United States free of cost and to the satisfaction of the Secretary of War."

The act of March 2, 1895, required the making of a definite survey and location of said improvement and the preparation of a cadastral map showing each piece of property required to be deeded to the United States, or from which a release is required, with its metes and bounds.

Proceedings under these acts were carried on by King County, Wash., in which the canal is located, during the years 1897-1900, and the full right of way and flowage privileges were accepted by the Government in 1900.

Under date of March 1, 1898, a Board of Engineer officers was appointed by the authority of the Secretary of War to consider and report upon the most feasible route for this waterway, with special reference to the terminal point at the south end. The above Board submitted a report on March 23, 1898, recommending that the waterway enter Puget Sound through Shilshole Bay and that the outer lock be located at the foot of Salmon Bay. These recommendations were

approved, and what is known as the Shilshole Bay route was adopted by the Secretary of War under date of April 14, 1898.

The act of June 13, 1902, provided for a dredged channel 10 feet deep at low water extending to the wharves at Ballard, and directed the appointment of a Board of Engineer officers to reexamine the whole question of a ship canal, and stipulated that nothing in said act should be construed as adopting any project for construction of the waterway. The report of this Board was adverse to the construction at that time of a canal of the dimensions proposed.

The first actual work of excavation along the route of the canal was done in 1901 under the acts of August 18, 1894, and June 3, 1896. The total amount of excavation under acts of 1894, 1896, 1902, and 1905, including that completed during the fiscal year, is 1,063,251 cubic yards. The result of this work is a channel 75 feet wide and 16 feet deep at extreme low water from deep water in Shilshole Bay to the lower lock site, a distance of 6,000 feet; a channel 75 feet wide and 10 feet deep at extreme low water from the lower lock site to the city wharf at Ballard, with a turning basin at the inner end 200 feet to 500 feet wide. The channel leading to the turning basin is 175 feet wide for a distance of about 1,000 feet. A cut 10 feet wide on the bottom and 10 feet above elevation 26 feet (the bottom of the canal as once proposed) has been excavated between the head of Salmon Bay and Lake Union, a distance of 4,500 feet. The total excavation mentioned above includes 945,374 cubic yards removed from Salmon and Shilshole bays, and 117,877 cubic yards removed between Salmon Bay and Lake Union. Regulating gates were installed at the Lake Union outlet and at the Portage, the Portage cut, excavated by private capital in 1886, was enlarged, and at the latter point three 30-inch syphons were installed to regulate the flow from Lake Washington.

On the 8th of February, 1901, the legislature of the State of Washington passed an enactment giving to the United States full right to occupy for the purpose of the canal any lands or waters belonging to the State and releasing the United States from all liability for damages arising from such occupancy or use.

The act of Congress of March 3, 1905, appropriating funds for continuing dredging in Salmon Bay, provided that "Nothing herein shall be construed as the adoption of any project for the construction of the waterway connecting Puget Sound with Lakes Union and Washington."

The amount expended to June 30, 1907, was \$460,969.12. Of this amount \$18,889.28 was expended in maintenance and on improvement of drainage of Lake Washington.

Descriptions of the work, etc., are published in Annual Reports of the Chief of Engineers for 1892, page 2762 et seq., and for 1896, page 3356 et seq. Estimate of approximate cost, \$6,331,672, with map showing main features of canal, is published in House Document No. 335, Fifty-seventh Congress, first session, and in the Annual Report for 1902, at page 2419. The report of General Alexander is printed in Senate Ex. Doc. No. 165, Fiftieth Congress, first session.

The report of the last Board of Engineers is published in Senate Document No. 127, Fifty-seventh Congress, second session, and is printed in Annual Report of the Chief of Engineers for 1903, page 2340 et seq.

Reports of examinations and surveys are referred to in the Report of the Chief of Engineers for 1904, page 696.

The present commerce benefited by the improvement of the channel to Ballard is the towing of logs to the mills at Ballard and the export of lumber and shingles from that place. Logs are brought in in rafts and lumber is loaded on sailing vessels and scows at the mills and then towed to the open Sound.

It has not been practicable to determine what effect the improvement work has had upon freight rates.

The maximum draft that could be carried to the wharves at Ballard, June 30, 1907, was 10 feet at low water. The maximum tidal variation is about 18 feet.

The communities interested in the project started a movement early in 1906 for the construction of the canal with local funds, and to this end secured the passage of an act of Congress approved June 11, 1906, authorizing James A. Moore or his assigns to construct a canal along the Government right of way connecting the waters of Puget Sound with Lake Washington. This act was modified by the act of March 2, 1907, so as to permit Mr. Moore, or his assigns, to commute the work required under the previous act to excavation alone of a canal from deep water in Puget Sound to deep water in Lake Washington with a bottom width of 75 feet and a depth at mean low water of 25 feet. The same act directed a survey and estimate of cost of a canal with a single lock and a report as to what contribution, if any, local interests would make toward its construction.

To assist the United States through the agency of the Moore acts in building a canal, the county of King voted a bond issue of \$500,000 on September 12, 1906. These bonds were declared invalid by the supreme court of the State, but the defects have been remedied by an act of the legislature and the bonds are now believed to be valid.

On March 13, 1907, the State legislature passed an act creating a local assessment district, embracing territory that would be benefited by the canal, and empowering the district to raise by taxation a sum not exceeding 1 per cent of the taxable valuation of the county, and to use the money so received to aid in constructing the canal. The board of appraisement was to be appointed by the local United States district judge, and the money is to be expended under the direction of the United States engineer officer in charge of the local engineer district.

Under this act the district has been duly formed by the necessary action of the county commissioners, the board of appraisement has been appointed and has entered upon its duties, and work is actively in progress toward raising the sum of \$1,075,000, enough, it is estimated, to cover all expenses of damages and right of way and still leave \$1,000,000 to be applied to actual construction. This sum, with the county bond issue, will make \$1,500,000 as the local contribution toward the canal in addition to the contribution of the right of way.

The work on the survey required by the act of March 2, 1907, is in progress. Notice from the Secretary of War requiring removal of existing bridges on the canal by July 8, 1908, has been served upon parties operating such bridges.



The work authorized by the act of Congress approved June 11, 1906, was commenced on June 4, 1907, and was in progress at the close of the year.

*Exports and imports.*

Calendar year.	Tons.	Value.	Calendar year.	Tons.	Value.
1901.....	410,565	\$2,002,950	1904.....	584,079	\$2,520,785
1902.....	428,073	2,432,401	1905.....	888,161	4,588,198
1903.....	524,500	2,219,900	1906.....	705,841	3,993,410

NOTE.—The above includes only the present commerce of Ballard and Salmon Bay, Lake Union, and Lake Washington.

The loading of vessels with lumber has been largely facilitated by the work done in Ballard Harbor. Formerly the lumber was taken out by means of lighters to the vessels anchored in the Sound. Now all but the largest vessels are brought to the mills to receive their loads.

July 1, 1906, balance unexpended.....	\$65,978.94
Amount appropriated by river and harbor act approved March 2, 1907.....	10,000.00
	<hr/> 75,978.94

June 30, 1907, amount expended during fiscal year:	
For works of improvement.....	\$64,830.06
For maintenance of improvement.....	2,118.00
	<hr/> 66,948.06

July 1, 1907, balance unexpended.....	9,030.88
July 1, 1907, outstanding liabilities.....	1,053.60
	<hr/>

July 1, 1907, balance available.....	7,977.28
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(See Appendix Y Y 8.)

9. *Everett Harbor, Washington.*—At this harbor the southern part of the water front has ample depth and is accessible for vessels of the deepest draft. The northern portion was inaccessible on account of the delta formation or tide flats off the mouth of the Snohomish River and the whole water front was exposed to westerly storms.

The original project was as follows:

First, to excavate a harbor basin in the shallows and tide lands adjoining deep water near the river's mouth; second, to dredge a channel from this through the tide flats and the Old River mouth to deep fresh water in the Snohomish River, this channel being designed to bring fresh water to the harbor basin and to afford facilities for navigation about the peninsula and into the deep water of the river bounding the peninsula on the east; and third, to protect and maintain this harbor and channel across the tide flats by a bulkhead interposed between them and the open waters of the Sound, the bulkhead to act as a retaining wall for the material dredged from the harbor.

By authority of joint resolution of Congress approved April 23, 1902, the work in Old River was discontinued, the project for a fresh-water basin was abandoned, and the further expenditure of the funds has been for deepening and widening the harbor basin and channel through the tide flats and repairing the bulkheads.

The estimated cost of the improvements was \$422,000, all of which has been appropriated.

The amount expended on project to June 30, 1907, was \$414,254.63, of which \$2,545.49 was for maintenance.

A dike for the purpose of retaining the dredged material has been built from the lower end of Smiths Island along the established bulkhead line for a distance of 19,336 feet. At the southern end of this work an outside bulkhead 200 feet from the other has been built for a distance of 2,600 feet. These dikes have been repaired, raised, and strengthened. The channel leading north from the basin had been dredged to a depth of 6 feet at low water for a distance of 6,000 feet. A channel in the Old River had been partly dredged for a distance of 11,600 feet downstream before this part of the work was discontinued under the resolution of Congress above referred to.

The harbor basin has been dredged for a length of 5,500 feet and for a width of 400 feet and depth of 26 feet at mean lower low water.

No work was in progress during the year.

The maximum draft that could be carried through the dredged area June 30, 1906, at low water was 26 feet. The tidal variation is approximately 15 feet.

The harbor of Everett is freely accessible to vessels of deepest draft up to the entrance to the dredged harbor basin. The water traffic is varied in character and is carried on by seagoing vessels and the various types of Sound and river boats. Lumber products, paper, and flour are the principal items of the export trade.

*Exports and imports.*

Calendar year.	Tons.	Value.	Calendar year.	Tons.	Value.
1898.....	55,460	\$2,545,054	1903.....	79,394	\$2,510,417
1899.....	42,713	1,477,120	1904.....	168,347	3,342,215
1900.....	55,094	1,820,561	1905.....	230,089	4,592,124
1901.....	71,881	2,712,260	1906.....	159,208	3,820,860
1902.....	85,263	4,024,584			

The effect of the completed dike as a breakwater and protection for the wharves and mills abreast of it has been very beneficial, but the channel and harbor basin dredged have not yet been utilized for commercial purposes.

Description of the work and maps are published in Annual Reports of the Chief of Engineers for 1895, pages 3430 to 3435, and for 1901, pages 3587 to 3589.

Reports on examinations, surveys, etc., are referred to in Annual Report of the Chief of Engineers for 1904, page 698.

Reference to report on an examination authorized by the river and harbor act of March 3, 1905, will be found on page 786 of Annual Report for 1906.

The amount expended during the year was for inspection of dredging work done by private contract.

July 1, 1906, balance unexpended.....	\$8,236.42
June 30, 1907, amount expended during fiscal year, for maintenance of improvement .....	491.05

July 1, 1907, balance unexpended..... 7,745.37

(See Appendix Y Y 9.)

10. *Swinomish Slough, Washington.*—This slough affords an inland sheltered passage for small vessels from Puget Sound proper northward to Bellingham Bay and the Gulf of Georgia, and it is the only means of communication to the town of La Conner, located on the slough. At the northern end the slough opens out through the mud flats of Padilla Bay and on the south into Saratoga Passage through the mud flats forming the delta of the Skagit River. The total distance from deep water in Saratoga Passage to deep water in Padilla Bay is about 11 miles. This waterway is of great importance to traffic between Puget Sound and points north in giving an inside passage for small craft in rough weather, and an outlet for the agricultural and timber products from the surrounding country.

The original and present project, adopted by Congress by act of July 13, 1892, contemplates dredging a channel 4 feet deep and 100 feet wide from deep water in Saratoga Passage across Skagit flats, through the shoals of the slough proper and across the flats of Padilla Bay to deep water, and building dikes in Skagit Bay to control the tidal currents.

The original estimated cost was \$122,000, which proved insufficient.

The amount expended to June 30, 1907, was \$132,045.45, of which \$31,233.45 was for maintenance of dikes.

The dike work completed to date between La Conner and Saratoga Passage is as follows: Single rows of piles to catch drift between Goat and Ika islands, 4,000 feet; wattled pile dike, 3,000 feet; pile brush, and stone dike, 7,200 feet. The brush and stone dike has been largely repaired and rebuilt and is doing effective work. The other dikes are badly deteriorated and are of little use.

Dredging has been carried from Saratoga Passage to about the middle point of the slough. A portion of this, between the passage and La Conner, has been filled up through the action of the tidal currents. That portion in the slough proper still shows the required depth.

The work has not yet progressed sufficiently to have any effect in lowering freight rates, so far as known, but the difficulties of navigating the slough in places have been reduced.

A report on examination and survey of Swinomish Slough, upon which the plan of improvement is based, is referred to in Annual Report of the Chief of Engineers for 1904, page 699.

A map showing parts of the improvement is published in the Annual Report of the Chief of Engineers for 1900, opposite page 4488.

The average tidal variation is about 8 feet.

No work was done during the past fiscal year, but that done during the year 1905 has been very effective in maintaining a good channel.

*Exports and imports.*

Calendar year.	Tons.	Value.	Calendar year.	Tons.	Value.
1898.....	19,625	\$882,345	1903.....	51,399	\$1,473,197
1899.....	76,636	2,028,454	1904.....	56,262	1,539,094
1900.....	74,516	1,611,460	1905.....	48,724	1,363,729
1901.....	136,747	2,991,330	1906.....	53,261	1,494,382
1902.....	49,914	1,472,847			

July 1, 1906, balance unexpended.....	\$770. 21
Amount appropriated by river and harbor act approved March 2, 1907..	75, 000. 00
	<hr/> 75, 770. 21
June 30, 1907, amount expended during fiscal year :	
For works of improvement.....	\$2, 045. 45
For maintenance of improvement.....	770. 21
	<hr/> 2, 815. 66
July 1, 1907, balance unexpended.....	72, 954. 55
July 1, 1907, outstanding liabilities.....	3, 539. 95
	<hr/> 69, 414. 60
(See Appendix Y Y 10)	

11. *New Whatcom Harbor, Washington.*—The local name of the town at this place is now Bellingham.

The mud flats in the harbor extend from the shore line to the 12-foot curve, a distance of 3,400 feet.

A system of harbor lines for this harbor, approved by the Secretary of War under date of June 3, 1892, provides for three waterways leading from deep water to the meander line.

The original and existing project, adopted by Congress by the act of June 13, 1902, contemplates dredging the Whatcom Creek waterway to a depth of 12 feet at mean lower low water and 200 feet wide from deep water as far as the railroad bridge and to its full width inside this bridge. The estimated cost is \$80,000.

The amount expended to June 30, 1907, was \$57,673.98, of which \$1,092.05 was for maintenance and inspections.

A channel 200 feet wide and 12 feet deep at low water, with turning basin at inner end, has been dredged under contract. The channel extends the full length of the waterway, and the basin at the inner end has full width of the waterway, 330 feet, and is 2,570 feet long.

During the year no work has been in progress.

The work contemplated by the project was completed at somewhat less than the estimated cost and a larger amount of dredging was done than was expected with the funds available.

The maximum draft that could be carried June 30, 1906, at low water over the full length of channel and turning basin was 12 feet. The range of tide is about 12 feet.

*Exports and imports.*

Calendar year.	Tons.	Value.
1902 .....	87, 118	\$2, 872, 789
1903 .....	101, 989	1, 835, 486
1904 .....	236, 609	4, 225, 480
1905 .....	254, 240	4, 690, 936
1906 .....	292, 592	5, 643, 504

The work has not yet produced any material effect on freight rates so far as known.

The commerce of this port is of a general nature, consisting largely of lumber, shingles, and fish. Vessels of the deepest draft can go as far as the entrance of the proposed dredged channel.

Description of proposed work is published in Annual Report of the Chief of Engineers for 1897, pages 3478 to 3481.

Reports on examination and survey are referred to in Annual Report of the Chief of Engineers for 1904, page 701.

July 1, 1906, balance unexpended.....	\$2, 495. 00
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	168. 98

July 1, 1907, balance unexpended.....	2, 326. 02
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(See Appendix Y Y 11.)

12. *Columbia River between Wenatchee and Bridgeport, Wash.*—The Columbia River between Wenatchee and Bridgeport, Wash., is about 80 miles in length, has sufficient depth for all purposes of navigation, and the only difficulties in the way of navigation are the swift currents and rocks and reefs which occupy the channels.

The project adopted by the river and harbor act approved August 18, 1894, for the improvement of the Columbia River between the head of Rock Island Rapids and the foot of Foster Creek Rapids included the part of the river between Wenatchee and Bridgeport, and the amount expended on the original project was \$8,005.20.

The existing project of November 16, 1905, adopted by act of March 2, 1907, contemplates the improvement of the river between Wenatchee and Bridgeport by the removal of rocks, bowlders, etc., and the construction of dikes and wing dams, at an estimated cost of \$42,000.

Nothing has been expended during the fiscal year.

The work of improvement has not been commenced on account of high stage of water.

The variation in water surface is about 20 feet.

*Exports and imports.*

Calendar year.	Tons.	Value.
1904 .....	24, 506	\$2, 251, 590
1905 .....	39, 827	3, 169, 060
1906 .....	53, 260	3, 901, 360

Report of a survey including this part of the Columbia River was published in Annual Report for 1895, pages 3534–3542.

Report on examination and survey of the part of the river between Wenatchee and Bridgeport was published in House Document No. 440, Fifty-ninth Congress, second session.

Amount appropriated by river and harbor act approved March 2, 1907.....	\$42, 000. 00
July 1, 1907, balance unexpended.....	42, 000. 00

(See Appendix Y Y 12.)

13. *Okanogan and Pend Oreille rivers, Washington.*—(a) *Okanogan River.*—This river rises in Canadian territory, flows in a southerly direction, and empties into the Columbia. The lower portion, for a distance of 87 miles, lies in the northeastern part of Washington. The lower portion has sufficient depth and width for light-draft steamboat navigation throughout a good portion of the year, but it is obstructed in places by shoals and rocks, which interfere with navigation during low water.

The original and existing project, adopted by Congress by act of March 3, 1899, contemplates rock removal, the construction of wing dams, and snagging. By act of June 13, 1902, this work and that of the Pend Oreille were consolidated.

The estimated cost was \$30,000 for the Okanogan. The amount expended to June 30, 1907, was \$37,937.79, of which \$5,973.45 was for maintenance.

Work of removing rocks and boulders, wing-dam construction, and placing posts to assist vessels in hauling over rapids has been done at various points over about 40 miles of the lower portion of the river.

Cables to assist vessels in passing the rapids were placed at seven places on the Okanogan River.

During the year work was carried on from December 27, 1906, to April 30, 1907.

The extreme variation of water levels at the junction with the Columbia is 37 feet; extreme variation 6 miles above said junction, 20 feet.

The commerce of the river is carried on in small river steamers and consists of general traffic.

*Exports and imports.*

Calendar year.	Tons.	Value.	Calendar year.	Tons.	Value.
1899.....	1,733	\$151,415	1903.....	6,317	\$458,705
1900.....	(a)	(a)	1904.....	1,636	252,414
1901.....	983	.....	1905.....	1,184	228,675
1902.....	1,571	119,065	1906.....	1,960	253,880

<sup>a</sup> Not obtainable.

The freight rates on this river are believed to have been materially reduced since the work started, but no definite information is available.

Descriptions of the river and the plan of improvement are given in the Annual Report of the Chief of Engineers for 1888, page 3121.

Report on examination of Okanogan River is published in Annual Report of the Chief of Engineers for 1895, page 3475; report of survey is referred to in Annual Report of the Chief of Engineers for 1904, page 702.

No additional work other than that of maintenance is contemplated on this stream.

July 1, 1906, balance unexpended.....	\$889. 12
Amount allotted from appropriation by river and harbor act approved	
March 2, 1907.....	5, 000. 00
Transferred from Pend Oreille River.....	1, 994. 58
	7, 883. 70
June 30, 1907, amount expended during fiscal year, for maintenance of improvement.....	3, 826. 91
July 1, 1907, balance unexpended.....	4, 056. 79
July 1, 1907, outstanding liabilities.....	25. 00
July 1, 1907, balance available.....	4, 031. 79

(b) *Pend Oreille River.*—This river forms the outlet of Pend Oreille Lake, in the northern part of Idaho.

The obstructions to navigation consist of rocks and shoals in Box Canyon and in the section between this canyon and Albany Falls.

The original and existing project, adopted by Congress by act of March 3, 1899, contemplates the improvement of Box Canyon by the removal of submerged rocks, the blowing off of projecting rocky points, and the removal of submerged rocks between Box Canyon and Albany Falls. The estimated cost was \$30,000.

The amount expended to June 30, 1907, was \$21,684.73, of which \$803.44 was for maintenance and inspections.

During the year no work has been done.

Box Canyon is now navigable except at high stages of water.

The river is navigable throughout the year from Newport down to Box Canyon, a distance of 54 miles, except occasional interruption from ice. A channel depth of about 4 feet can be depended on.

The extreme variation of water levels in the main river is from 17 to 20 feet; in Box Canyon the difference between extreme high and extreme low water is 48 feet.

The commerce consists of towing logs and general traffic carried on by a number of small vessels. Heavy freight is carried mainly on barges in tow.

*Exports and imports.*

Calendar year.	Tons.	Value.	Calendar year.	Tons.	Value.
1899.....	2,617	\$129,677	1903.....	27,100	\$753,000
1900.....	1,921	97,125	1904.....	39,974	358,458
1901.....	13,917	134,280	1905.....	54,733	462,814
1902.....	15,868	500,200	1906.....	32,943	501,834

No effect on freight rates directly attributable to the improvement has been reported.

Descriptions of the river and the plan of improvement are given in the Annual Report of the Chief of Engineers for 1898, page 3124.

Report of survey of the river is referred to in the Annual Report of the Chief of Engineers for 1904, page 702.

The river and harbor act of March 2, 1907, appropriated \$20,000 for work on this river and the Okanogan. It is proposed to apply the greater portion of this sum on the Pend Oreille in dredging through the clay bars between Newport and Box Canyon.

July 1, 1906, balance unexpended..... \$6,048.24  
Amount allotted from appropriation by river and harbor act approved  
March 2, 1907..... 15,000.00

Transferred to Okanogan River..... 21,048.24  
1,994.58

June 30, 1907, amount expended during fiscal year, for maintenance  
of improvement ..... 19,053.66  
232.97

July 1, 1907, balance unexpended ..... 18,820.69  
July 1, 1907, outstanding liabilities..... 125.00

July 1, 1907, balance available..... 18,695.69

## CONSOLIDATED.

July 1, 1906, balance unexpended.....	\$6,937.36
Amount appropriated by river and harbor act approved March 2, 1907.....	20,000.00
	<hr/> 26,937.36
June 30, 1907, amount expended during fiscal year, for maintenance of improvement .....	4,059.88
July 1, 1907, balance unexpended .....	22,877.48
July 1, 1907, outstanding liabilities .....	150.00
	<hr/>
July 1, 1907, balance available.....	22,727.48

(See Appendix Y Y 13.)

EXAMINATION AND SURVEY MADE IN COMPLIANCE WITH RIVER AND  
HARBOR ACT APPROVED MARCH 3, 1905.

Report dated June 26, 1905, on *preliminary examination of Columbia River and tributaries above Snake River, Washington*, and report dated November 16, 1905, on a *survey of Columbia River between Wenatchee and Bridgeport, Washington*, required by the river and harbor act of March 3, 1905, were submitted by the district officer and were reviewed by the Board of Engineers for Rivers and Harbors, pursuant to law. They were transmitted to Congress and printed in House Document No. 440, Fifty-ninth Congress, second session. A plan for improvement between Wenatchee and Bridgeport at an estimated cost of \$42,000 is presented.

RIVER AND HARBOR IMPROVEMENTS IN ALASKA.

This district was in the charge of Capt. G. B. Pillsbury, Corps of Engineers. Division engineer, Col. W. H. Heuer, Corps of Engineers, to March 2, 1907, and Lieut. Col. S. W. Roessler, Corps of Engineers, since June 3, 1907.

1. *St. Michael Canal, Alaska.*—The St. Michael Canal is a channel running from St. Michael Bay to a point on Norton Sound about 38 miles from the Apoon mouth of the Yukon River.

The port of St. Michael is about 3 miles from the mouth of the canal.

The main part of the canal has sufficient water for the navigation of river boats plying on the Yukon River. The eastern entrance to the canal is, however, obstructed by shoals, and in the eastern portion there are several sharp bends that could be turned with difficulty by the larger river boats.

The object of the improvement of the canal is to provide a sheltered passage to river boats between St. Michael and the mouth of the Yukon River.

The original and existing project contemplates dredging in the South Branch a channel 100 feet wide to a depth of 6 feet at the entrance to the canal and the excavation of a cut of the same dimensions across the first bends. The estimated cost is \$248,000. The project was adopted by the act of March 2, 1907, which appropriated \$98,000 and authorized continuing contracts for completing the project in the sum of \$150,000, yet to be appropriated.



No funds have been expended up to the close of the fiscal year ending June 30, 1907.

No work has been done up to June 30, 1907. Contracts for the work under a continuing contract appropriation are being advertised.

The maximum draft that can at present be carried at low water is 3 feet. The mean range of tide is  $3\frac{1}{2}$  feet.

*Statement of freight between St. Michael and mouth of Yukon River.*

Calendar year.	Tons.	Value.	Calendar year.	Tons.	Value.
1897.....	5,270	\$512,650	1902.....	16,008	\$1,630,950
1898.....	22,117	2,132,580	1903.....	20,000	1,652,891
1899.....	17,295	1,704,525	1904.....	17,356	1,316,237
1900.....	19,153	1,950,950	1905.....	25,855	2,220,830
1901.....	18,153	1,844,651			

Report of examination and survey is published in House Document No. 389, Fifty-ninth Congress, second session.

Amount appropriated by river and harbor act approved March 2,

1907 ----- \$98,000.00

July 1, 1907, balance unexpended----- 98,000.00

July 1, 1907, outstanding liabilities----- 32.50

July 1, 1907, balance available----- 97,967.50

Amount (estimated) required for completion of existing project----- 150,000.00

{ Amount that can be profitably expended in the fiscal year ending  
June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907----- 150,000.00  
Submitted in compliance with the requirements of the sundry civil act of June 4, 1897.

(See Appendix Z Z 1.)

2. *Removing sunken vessels or craft obstructing navigation.—Wreck of the steamer Rock Island from the Tanana River in front of Chena, Alaska.*—Bids for removing the wreck under emergency contract were called for.

No funds were expended up to June 30, 1907.

(See Appendix Z Z 2.)

EXAMINATION AND SURVEY MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF MARCH 3, 1905.

Reports dated July 5, 1905, and November 16, 1906, required by the river and harbor act approved March 3, 1905, on *preliminary examination and survey, respectively, of St. Michael Canal, Alaska, with a view to straightening and otherwise improving the same* were submitted by the district officer and were reviewed by the Board of Engineers for Rivers and Harbors, pursuant to law. They were transmitted to Congress and printed in House Document No. 389, Fifty-ninth Congress, second session. A plan for improvement at an estimated cost of \$248,000 is presented.

## RIVER AND HARBOR IMPROVEMENTS IN THE TERRITORY OF HAWAII.

This district was in the charge of Capt. J. R. Slattery, Corps of Engineers, to December 31, 1906, and of Capt. C. W. Otwell, Corps of Engineers, since that date. Division engineer, Col. W. H. Heuer, Corps of Engineers, to March 2, 1907, and Lieut. Col. John Biddle, Corps of Engineers, since June 12, 1907.

1. *Honolulu Harbor, Hawaii*.—This harbor is situated on the south coast of the island of Oahu. It is formed by a coral reef, a narrow channel through the reef affording access to the harbor. The entrance channel and harbor proper were dredged from time to time by the monarchical, republican, and Territorial governments of Hawaii prior to July 1, 1904. On this date there existed an entrance channel having a depth of about 35 feet and a minimum width of about 200 feet at mean low water. The harbor proper (that portion commencing at the light-house and extending to the mouth of the Nuuanu River) had a general width of 900 feet. The water for about 200 feet immediately along the wharves had a depth of from 30 to 32 feet. Elsewhere there was only about 27 feet at low water. The bend at the light-house point was so sharp as to make it somewhat difficult for large vessels to make the turn. The shallowness of the water in the harbor made it impossible for the largest vessels calling at the port to enter the harbor when at all heavily laden. The narrowness of the harbor made turning difficult for all ships.

Work on the present project was begun under an appropriation by the river and harbor act of March 3, 1905, in accordance with a general plan printed in the Annual Report of the Chief of Engineers for 1905, page 2564, but the project as specifically adopted by the river and harbor act of March 2, 1907, is printed in House Document No. 332, Fifty-ninth Congress, second session. It provides for an entrance channel 35 feet deep and 400 feet wide at mean low water from deep water at the entrance to the light-house point, for easing the curve at the junction of the entrance channel and the inner harbor by cutting off the light-house point, and for enlarging the harbor proper so that it will have a depth of 35 feet and a general width of 1,200 feet at mean low water, at an estimated cost of \$1,628,894.60, exclusive of a new front range light, estimated to cost \$30,000.

The act of 1907 appropriated \$200,000 and authorized continuing contracts for prosecuting the project in the additional sum of \$200,000, which is yet to be appropriated.

Work has been carried on under a continuing contract for dredging in sections A and B.

All materials of sections A and B (the removal of which was contemplated by the contract entered into September 12, 1905) having been dredged, and Quarantine Island (the reclamation of which was to be undertaken in connection with the operations then under way) still being below grade, an open-market agreement was entered into with the same contractor, whereby 58,755 cubic yards of material was removed and deposited on Quarantine Island.

The sum of \$8 was derived from sale of blueprints.

On June 30, 1907, the sum of \$169,378.79 had been expended, leaving a balance of \$237,529.40; no part of this expenditure was for maintenance.

The work under the present project has resulted in an entrance channel 400 feet wide and 35 feet deep at mean low water, except near the marine railway and along the edges where hard coral was encountered. The harbor proper has a general width of 900 feet, a length of about 3,000 feet, and a minimum depth of 35 feet.

For detailed statement of lands reclaimed with materials dredged in connection with the improvement see page 788 of the Annual Report of the Chief of Engineers for 1906.

The commerce of this port for the past calendar year was valued at \$29,808,740 and amounted to more than 355,750 tons.

July 1, 1906, balance unexpended.....	\$206, 900. 19
Proceeds of sale of blueprints.....	8. 00
Amount appropriated by river and harbor act approved March 2, 1907.....	200, 000. 00
	<hr/> 406, 908. 19
June 30, 1907, amount expended during fiscal year, for works of improvement.....	169, 378. 79
July 1, 1907, balance unexpended.....	237, 529. 40
July 1, 1907, outstanding liabilities.....	351. 32
	<hr/> 237, 178. 08
July 1, 1907, balance available.....	<hr/> 237, 178. 08
Amount (estimated) required for completion of existing project.....	1, 028, 894. 60
<hr/>	
{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907.....	
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897.	
	200, 000. 00

(Appendix A A A 1.)

2. *Reclamation of Quarantine Island, Honolulu, Hawaii.*—Quarantine Island was originally a low, swampy island lying on the reef, on the side of Honolulu Harbor, opposite the city. The quarantine authorities had scraped up the shallow layer of sand overlying the coral reef, and raised the land immediately surrounding the buildings and the roads to a height of about 2 feet above high water. Practically all the rest of the island was submerged at high water.

The original project, adopted February 27, 1906, provides for reclaiming the low and swampy portions of Quarantine Island lying within the concrete sea wall, by pumping materials dredged from Honolulu Harbor to fill the same at an estimated cost of \$20,000.

A contract was entered into on April 10, 1906, and completed on August 6, 1906. A survey made in October, 1906, showed a considerable portion of the island below grade and large cracks appearing, due to the drying out of the materials.

A project approved on June 17, 1907, provides for bringing the low places to grade by filling in, by means of a hoisting engine and scraper, materials lying on the coral reef in front of the sea wall. The work which is being done by day labor was started on June 18 and has consisted in assembling the plant and removal of about 200 cubic yards of material.

At the close of the fiscal year the sum of \$16,125.81 had been expended. No part of this was for maintenance.

For commercial statistics see report for improving Honolulu Harbor Hawaii.

July 1, 1906, balance unexpended.....	\$19, 754. 35
June 30, 1907, amount expended during fiscal year, for works of improvement.....	16, 125. 81
July 1, 1907, balance unexpended.....	3, 628. 54
July 1, 1907, outstanding liabilities.....	496. 40
July 1, 1907, balance available.....	3, 132. 14

(See Appendix A A A 2.)

3. *Harbor at Hilo, Hawaii.*—Hilo Bay is practically an open roadstead, protected to a limited extent by Blonde reef, but otherwise exposed through the angle formed by lines drawn from Hilo town to Kanaha and Keokea points—that is, from about north to north 74° east magnetic. Strong northeasterly winds prevail most of the time. These winds cause a choppy sea outside of Hilo Bay and considerable swell in the bay, which at times makes it unsafe for ships to lie at the existing wharves and renders loading and unloading in the bay difficult. The heaviest seas, however, come from the north during northerly and northwesterly storms, and during this weather it is often impossible for ships to lie at the wharves or even work in the bay.

The present project consists in constructing a breakwater along Blonde reef to Coconut Island, at an estimated cost of \$1,700,000. It is printed in House Document No. 407, Fifty-ninth Congress, second session.

The project was adopted by the river and harbor act of March 2, 1907, which appropriated \$200,000 and authorized continuing contracts for prosecuting the work in the additional sum of \$200,000 yet to be appropriated. The act also authorized a modification of the plan in the discretion of the Secretary of War and directed that no expenditures be made unless the Chief of Engineers, upon further investigation, shall determine that commercial benefits accruing therefrom will warrant the same.

No work was done or funds expended during the fiscal year ending June 30, 1907.

It is proposed to apply the balance available and the additional appropriation recommended to constructing the breakwater.

The commerce of this port for the calendar year 1906 was valued at \$6,623,454.

Amount appropriated by river and harbor act approved March 2, 1907.....	\$200, 000. 00
July 1, 1907, balance unexpended.....	200, 000. 00

Amount (estimated) required for completion of existing project.....	1, 500, 000. 00
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{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907.....	200, 000. 00
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897.....	

(See Appendix A A A 3.)

#### EXAMINATION AND SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF MARCH 3, 1905.

Reports on preliminary examination and surveys required by the river and harbor act approved March 3, 1905, of the following localities within this district were submitted by the district officer. They

were reviewed by the Board of Engineers for Rivers and Harbors, pursuant to law, and were transmitted to Congress and printed in documents as indicated:

1. *Survey of Honolulu Harbor, Hawaii*.—Report dated October 23, 1906, is printed in House Document No. 332, Fifty-ninth Congress, second session. The cost of improvement of the harbor as revised in this report is estimated at \$1,628,894.60.

2. *Preliminary examination and survey of harbor at Hilo, island of Hawaii, with a view to the construction of a breakwater along Blonde reef to Cocoanut Island*.—Reports dated September 12, 1905, and October 27, 1906, respectively, are printed in House Document No. 407, Fifty-ninth Congress, second session. A plan for improvement at an estimated cost of \$1,700,000, is presented.

#### RIVER AND HARBOR IMPROVEMENTS IN PORTO RICO.

This district was in the charge of Maj. Chas. L. Potter, Corps of Engineers. Division engineer, Col. Amos. Stickney, Corps of Engineers, until June 7, 1907, and Col. D. W. Lockwood, Corps of Engineers, since that date.

1. *Harbor at San Juan, Porto Rico*.—This harbor has a very large area, but only a small portion is of a depth sufficient to accommodate modern shipping. There is a small area in the bend, where final entrance is made to the harbor proper, with a depth of 30 feet; the remainder of the available harbor ranges from 20 to 30 feet. A very narrow and somewhat crooked entrance channel has a least depth of 27 feet. The usual variation in water level between high and low tide is only about 1 foot. The existing project adopted by the river and harbor act of March 2, 1907, is to dredge an entrance channel 600 feet wide from deep water outside to a point opposite Morro Point; 500 feet wide from there to La Puntilla, both to be 30 feet deep, and both to be widened where they make the turn around these points; and to dredge, east of La Puntilla, harbor areas amounting to 398,600 square yards to a depth of 30 feet and 70,200 square yards to a depth of 24 feet, all in accordance with House Document No. 914, Fifty-ninth Congress, first session.

The estimated cost of this improvement is \$757,500, of which the act of March 2, 1907, appropriated \$157,500 and authorized continuing contracts for prosecuting the project in the sum of \$600,000 yet to be appropriated. The amount expended to June 30, 1907, not including outstanding liabilities, was \$979.97; all of which was expended in matters incident to outfitting an office and preparing specifications for the work.

No work has been done prior to this project by the United States, but some dredging was done by the Spanish Government.

The amount estimated that can be profitably expended during the year ending June 30, 1909, will be expended in continuing dredging under the contract for the entire work to be made in August, 1907, and, if carried out, the work should be more than half completed by the later date.

Amount appropriated by river and harbor act approved March 2, 1907-----	\$157,500.00
June 30, 1907, amount expended during fiscal year, for works of improvement-----	979.97
July 1, 1907, balance unexpended-----	156,520.03
July 1, 1907, outstanding liabilities-----	350.00
July 1, 1907, balance available-----	156,170.03
Amount (estimated) required for completion of existing project---	600,000.00
<hr/>	
{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for works of improvement, in addition to the balance unexpended July 1, 1907-----	300,000.00
{ Submitted in compliance with requirements of sundry civil act of June 4, 1897.	

(See Appendix B B B 1.)

2. *Removing sunken vessels or craft obstructing or endangering navigation.*—Wreck of the tugboat *Mayaguez* in the harbor of Ponce, Porto Rico.—This wreck was examined in the latter part of May, and the owner given thirty days notice from June 4 to remove the wreck if he desired. There were no expenditures during the year.

(See Appendix B B B 2.)

#### EXAMINATIONS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF MARCH 3, 1905.

Reports on preliminary examinations required by the river and harbor act of March 3, 1905, of the following localities within this district were duly submitted by the district officer. They were reviewed by the Board of Engineers for Rivers and Harbors pursuant to law and were transmitted to Congress and printed in documents, as indicated:

1. *Preliminary examination of Great Harbor, Culebra Island, Porto Rico.*—Report dated May 26, 1905, is printed in House Document No. 180, Fifty-ninth Congress, second session. Improvement of the harbor by the United States is not deemed advisable.

2. *Preliminary examination of harbor at Ponce, Porto Rico.*—Report dated June 6, 1906, is printed in House Document No. 267, Fifty-ninth Congress, second session. The locality is not deemed worthy of being improved by the United States.

3. *Preliminary examination of harbor at Mayaguez, Porto Rico.*—Report dated June 16, 1906, is printed in House Document No. 268, Fifty-ninth Congress, second session. The harbor is not deemed worthy of improvement by the United States.

#### THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS.

Section 3 of the river and harbor act of June 13, 1902, provided for the organization, in the Office of the Chief of Engineers, by detail from time to time from the Corps of Engineers, of a Board of five engineer officers, whose duties shall be fixed by the Chief of Engineers, and to whom shall be referred for consideration and recommendation, in addition to any other duties assigned, so far as in

the opinion of the Chief of Engineers may be necessary, all reports upon examinations and surveys provided for by Congress, and all projects or changes in projects for works of river and harbor improvement theretofore or thereafter provided for. It is further the duty of the Board, upon request to the Chief of Engineers, by the Committee on Commerce of the Senate, or the Committee on Rivers and Harbors of the House of Representatives, in the same manner to examine and report through the Chief of Engineers upon any projects heretofore adopted by the Government or upon which appropriations have been made, and to report upon the desirability of continuing the same or upon any modifications thereof which may be deemed desirable. This provision of the law was extended by act of March 3, 1905, to require the Board, upon request of the committees of Congress specified above, to examine and review surveys as well as projects provided for by acts or resolutions prior to the river and harbor act of June 13, 1902, and it was further modified by the act of March 2, 1907, to include consideration of any examination or survey made pursuant to any act or resolution of Congress.

During the past fiscal year the Board was composed of the following officers of the Corps of Engineers: Col. D. W. Lockwood; Col. R. L. Hoxie; Maj. C. McD. Townsend, temporarily, from November 8 to December 8, 1906; Maj. W. C. Langfitt, to December 8, 1906; Maj. E. Eveleth Winslow since August 3, 1906; Maj. Chester Harding since December 8, 1906; Capt. Charles W. Kutz to December 8, 1906, and Capt. William J. Barden since December 8, 1906.

For consideration of the report of a Board of Engineers on the improvement of the Ohio River only, it is composed of the following officers of the Corps of Engineers: Col. H. M. Adams, Col. Chas. E. L. B. Davis, Col. R. L. Hoxie, Lieut. Col. C. McD. Townsend, and Maj. E. Eveleth Winslow.

Under the provisions of the river and harbor acts of March 3, 1905, and March 2, 1907, all reports on preliminary examinations and surveys required by those acts received up to the close of the fiscal year have been referred to the Board for consideration and recommendation; in addition, a number of subjects have been presented to it for report in accordance with resolutions of the Committee on Rivers and Harbors of the House of Representatives and the Committee on Commerce of the Senate. The reports rendered by the Board from time to time have been duly presented to Congress.

Details of the operations of the Board during the past fiscal year will be found in Appendix C C C.

#### SUPERVISION OF THE HARBOR OF NEW YORK.

The supervisor of the harbor during the past year was Lieut. Commander Louis R. de Steiguer, U. S. Navy, to August 30, 1906, and Commander H. H. Hosley, U. S. Navy, since that date.

The office of supervisor of the harbor of New York was created by act of Congress approved June 29, 1888, entitled "An act to prevent obstructive and injurious deposits within the harbor and adjacent waters of New York City, by dumping or otherwise, and to punish and prevent such offenses." This act has been amended by section 3 of the act of August 18, 1894, entitled "An act making appropriations

for the construction, repair, and preservation of certain public works on rivers and harbors, and for other purposes," by which amendment the functions and powers of the officer have been greatly enlarged. Additional duties are also conferred on the supervisor by section 2 of the last-named act.

Under the provisions of section 5 of the act of June 29, 1888, a line officer of the Navy is designated to discharge the duties created by the act under the direction of the Secretary of War. On May 23, 1889, the Secretary of War directed that all communications in connection with these duties should be addressed to him through this office, and on February 1, 1890, he further directed that the powers conferred upon him by the act should be exercised through the Chief of Engineers.

The report of Commander Hosley for the past fiscal year is submitted herewith as Appendix D D D.

*Estimates for the fiscal year ending June 30, 1909.*—The estimates of funds required for this service for the fiscal year ending June 30, 1909, are given in the above-mentioned report, as follows:

For pay of inspectors, deputy inspectors, office force, and expenses of office.....	\$10,260.00
For pay of crews and maintenance of patrol fleet.....	80,000.00
For renewing engines and boilers of steam tug <i>Vigilant</i> .....	15,000.00
For purchase or construction of one steam tug.....	50,000.00
Total .....	155,260.00

#### CALIFORNIA DÉBRIS COMMISSION.

Unrestricted mining by the hydraulic process in California resulted in enormous quantities of débris being washed down into the rivers and natural water courses draining the western slopes of the Sierras. Later on hydraulic mining was practically prohibited by the decisions of the courts on account of injury to streams and the adjacent private land.

For information in detail concerning hydraulic mining in the State of California in the early years, the damage caused by it to streams and adjacent lands, and the various plans and projects submitted for enabling hydraulic mining to be resumed and at the same time protect the other interests involved, attention is invited to the House documents referred to at page 3694 of the Annual Report of the Chief of Engineers for 1904.

The act of Congress approved March 1, 1893, created the California Débris Commission, stipulating that the Commission should consist of three officers of the Corps of Engineers, appointed by the President, with the concurrence of the Senate. The same act prescribed the duties of the Commission, which are, first, the regulation of hydraulic mining in the territory drained by the Sacramento and San Joaquin river systems, so that mining by that method may be resumed and carried on without injury to other interests in the State, and, second, to mature and adopt plans to improve the navigability of the above-mentioned rivers, to protect same from damage due to mining débris, and to afford relief thereto in flood time, etc.

The following statement shows the present condition for purposes of navigation of the three principal streams comprising the Sacramento and San Joaquin river systems:



	Sacramento River.	Feather River.	San Joaquin River.
Maximum draft that can be carried at low water.	San Francisco to Sacramento, 7 feet; Sacramento to Colusa, 4 to 5 feet; Colusa to Red Bluff, 26 inches.	Mouth of river to Marysville, 1 to 2 feet.	Mouth of river to Stockton, 9 feet; Stockton to Firebaugh, a few inches.
Head of navigation ...	Red Bluff. ....	Marysville. ....	Stockton (Firebaugh 4 months in year).
Length, in miles, of navigable portions.	Mouth to Sacramento, 64 miles; mouth to Colusa, 155 miles; mouth to Red Bluff, 255 miles.	Mouth to Marysville, 30 miles.	Mouth to Stockton, 50 miles; mouth to Firebaugh, 200 miles.

The maintenance of navigation on the Sacramento and San Joaquin river systems is important. Upward of 1,000,000 tons of freight is carried annually by vessels of all classes plying the Sacramento, San Joaquin, Mokelumne, and Feather rivers. This commerce consists principally of grain, mill stuffs, lumber, groceries, fruit, vegetables, and general merchandise. The commerce is carried principally on barges towed by steamboats and on scow-schooners. About thirty stern-wheel steamboats, many barges and launches, and about seventy-five scow-schooners are engaged in this trade. Much of the fertile country along the Sacramento River below the city of Sacramento and along the San Joaquin River below the city of Stockton is without railroad transportation, owing to the expense and difficulties of the construction and maintenance of railroads in a low-land country which is subject to more or less widespread floods annually. These fertile lands are protected ordinarily from overflow by extensive levee systems, constructed and maintained at great expense, and the rivers are in many cases the only means of transporting freight and passengers to and from most of this country. The rates by river to some points which can also be reached by railroad, notably on the upper Sacramento River, between the city of Sacramento and Red Bluff, are from 25 to 35 per cent lower than by rail.

*Regulation of hydraulic mining.*—Up to June 30, 1907, the Commission received 786 applications to mine by the hydraulic process, and granted permits in cases where means for properly impounding the débris were provided by the applicants.

*Improvement and protection of rivers.*—The Yuba River, a tributary of the Feather, which in turn is a tributary of the Sacramento River, was the first selected for treatment, this stream being more filled with débris and perhaps carrying more detritus than all the other tributaries of the Sacramento combined. The general project for the treatment of the Yuba was printed in the Annual Report of the Chief of Engineers for 1900, Part 8, page 5030. The estimated total cost of this project was placed at \$800,000. It was adopted by act of Congress approved June 13, 1902. The estimated total cost of the project has been appropriated—\$400,000 by Congress and \$400,000 by the legislature of California, the appropriations by Congress stipulating that one-half the cost of the work should be paid by the State of California. The Yuba River project contemplates holding the great quantities of mining débris now in that stream and tributaries, to prevent it from being carried down into the Feather and Sacra-

mento rivers. This was to be accomplished by four restraining barriers, or dams, across the bed of the Yuba, by a settling basin adjoining the river on the south, and by training walls below.

The amount expended by the United States on the existing project for the treatment of Yuba River up to June 30, 1907, was \$258,586.22. These expenditures were principally in payment of one-half the purchase price of upward of 10,000 acres of land required; in payment of one-half the cost of the construction of portions of barriers, or dams, in Yuba River, known as Nos. 1 and 2; of one-half the cost of excavating a flood overflow channel through the promontory on Yuba River known as Daguerre Point, and of one-half the cost of constructing training works to confine the flow of Yuba River below Daguerre Point.

Disastrous and widespread floods occurred throughout central California during March, 1907. During this flood about 600 feet of Barrier No. 1, then full of mining débris, was destroyed. It is not considered advisable to rebuild this barrier, and no further work on it is contemplated. Instead, it is proposed to complete the barrier at Daguerre Point and the settling basin immediately below, and to use these basins for storage of all débris. The training walls below Daguerre Point cut will also be completed. For work on the Sacramento and Feather rivers and their other tributaries dredging is considered the only feasible method.

The members of the Commission during the past fiscal year were Col. W. H. Heuer until February 15, 1907, Lieut. Col. John Biddle since May 4, 1907, Maj. C. H. McKinstry, Maj. Wm. W. Harts until May 4, 1907, and Capt. Thos. H. Jackson since February 15, 1907.

The appended money statement for appropriation for restraining mine débris in California includes only funds appropriated by Congress, and does not include funds appropriated by the legislature of California.

#### APPROPRIATION FOR EXPENSES OF CALIFORNIA DÉBRIS COMMISSION, 1907.

July 1, 1906, amount appropriated by act of Congress approved June 30, 1906 .....	\$15,000.00
June 30, 1907, amount expended during fiscal year .....	<sup>a</sup> 12,772.51
July 1, 1907, balance unexpended .....	2,227.49
July 1, 1907, outstanding liabilities .....	805.47
July 1, 1907, balance reverting to Treasury .....	1,422.02

#### APPROPRIATION FOR EXPENSES OF CALIFORNIA DÉBRIS COMMISSION, 1906-1907.<sup>b</sup>

July 1, 1906, amount appropriated by act of Congress approved June 30, 1906 .....	\$5,000.00
June 30, 1907, amount expended during fiscal year .....	5,000.00

<sup>a</sup> In addition there was expended during the year \$706.46 from appropriation for fiscal year 1906.

<sup>b</sup> Special appropriation to restore property and records of California Débris Commission, destroyed by fire in San Francisco, Cal., in April, 1906.

## APPROPRIATION FOR EXPENSES OF CALIFORNIA DÉBRIS COMMISSION, 1908.

Amount appropriated by act of Congress approved March 4, 1907-----	\$15,000.00
Amount (estimated) required for expenses of the California Débris Commission during the fiscal year ending June 30, 1909, in regulating hydraulic mining operations in the State of California and making examinations and surveys for débris storage sites, as required by the act of Congress approved March 1, 1893-----	15,000.00

## APPROPRIATION FOR RESTRAINING MINE DÉBRIS IN CALIFORNIA.

July 1, 1906, balance unexpended-----	\$187,508.89
June 30, 1907, amount expended during fiscal year, for works of improvement-----	46,095.11
July 1, 1907, balance unexpended-----	141,413.78
July 1, 1907, outstanding liabilities payable by United States-----	1,636.12
July 1, 1907, balance available-----	139,777.66
July 1, 1907, amount of United States funds covered by uncompleted contract-----	538.35

(See Appendix E E E.)

## EXAMINATION OF MISSISSIPPI RIVER WITH A VIEW TO PROVIDING AND MAINTAINING A NAVIGABLE CHANNEL 14 FEET DEEP AND OF SUITABLE WIDTH FROM ST. LOUIS TO THE MOUTH.

Under the provisions of the river and harbor act of March 2, 1907, a Commission has been appointed to examine the Mississippi River below St. Louis and report upon the practicability and desirability of constructing and maintaining a navigable channel 14 feet deep and of suitable width from St. Louis to the mouth of the river either by open-channel improvement or by a canal or canals for part of said route. The Commission is also required by the act to consider in this connection the survey of a proposed waterway from Chicago to St. Louis heretofore reported upon (see House documents No. 263, Fifty-ninth Congress, first session, and No. 437, Fifty-ninth Congress, second session), and also to report upon any water power which may be created in the said section of the Mississippi River below St. Louis, as well as in the proposed waterway from Chicago to St. Louis, and upon what steps, if any, should be taken to cause the cost of improvement to be defrayed in whole or in part by means of such water power or of lands which may be drained by either of said waterways.

The members of the Commission are Col. Clinton B. Sears, Corps of Engineers, president, Mississippi River Commission; Lieut. Col. W. H. Bixby, Corps of Engineers; Lieut. Col. C. McD. Townsend, Corps of Engineers; Mr. Henry B. Richardson, member of the Mississippi River Commission, and Mr. Homer P. Ritter, member of the Mississippi River Commission, with Capt. G. R. Lukesh, Corps of Engineers, as recorder.

The sum of \$190,000 was appropriated by the act to defray the expense of the survey, of which \$250.70 had been expended to June 30, 1907.

## MISSISSIPPI RIVER COMMISSION.

The Mississippi River Commission, constituted by act of Congress of June 28, 1879, is in charge of the improvement of the Mississippi River from Head of Passes to the mouth of the Ohio River, including

the rectification of Red and Atchafalaya rivers at their junction with the Mississippi, the building of levees, and the improvement of the several harbors for which specific appropriations have been made, with the exception of the harbor of Vicksburg and the mouth of Yazoo River. It is also charged with the survey of the Mississippi River from Head of Passes to its headwaters, and with gauging the river and its tributaries.

The river and harbor acts of March 3, 1905, and March 2, 1907, prescribed that the money therein appropriated and authorized to be expended should be applied to the construction of suitable and necessary dredge boats and other devices and appliances and in the maintenance and operation of the same, with the view of ultimately obtaining and maintaining a navigable channel from Cairo down not less than 250 feet in width and 9 feet in depth at all periods of the year, except when navigation is closed by ice. They also authorized allotments from such funds in the discretion of the Commission and upon approval by the Chief of Engineers, to be applied to the water courses connected with the river and the harbors upon it now under the control of the Mississippi River Commission.

Act of Congress approved June 4, 1906, provides that any funds which have been, or may hereafter be, appropriated by Congress for improving the Mississippi River between the Head of Passes and the mouth of the Ohio River, and which may be allotted to levees, may be expended under the direction of the Secretary of War, in accordance with the plans, specifications, and recommendations of the Mississippi River Commission, as approved by the Chief of Engineers, upon levees upon any part of said river between the Head of Passes and Cape Girardeau, Mo.

The act of March 2, 1907, provided for prosecution of the work under continuing contract and authorized expenditures in the sum of \$6,000,000, yet to be appropriated, provided that this sum shall be used in improvement for not less than three years, the work done each year to cost approximately \$2,000,000.

The Commissioners during the past fiscal year were Col. Clinton B. Sears, Corps of Engineers, president; Lieut. Col. James L. Lusk, Corps of Engineers, to August 8, 1906; Lieut. Col. Thos. L. Casey, Corps of Engineers, to August 14, 1906; Lieut. Col. Wm. T. Rossell, Corps of Engineers, since August 8, 1906; Maj. J. G. Warren, Corps of Engineers, since August 14, 1906; Homer P. Ritter, assistant, United States Coast and Geodetic Survey; Robert S. Taylor, J. A. Ockerson, and Henry B. Richardson.

Capt. W. B. Ladue, Corps of Engineers, was on duty as secretary to the Commission to July 18, 1906, and Capt. G. R. Lukesh, Corps of Engineers, since that date.

The report of the Commission on the operations under its charge during the fiscal year ending June 30, 1907, is submitted herewith as Appendix O O O of this report.

*Estimate for the fiscal year ending June 30, 1909.*—The following estimate of funds required for carrying on the works under its charge for the year ending June 30, 1909, is submitted by the Commission:

For continuing the improvement of the Mississippi River from Head of Passes to the mouth of the Ohio River, including salaries and clerical, office, traveling, and miscellaneous expenses of the Mississippi River Commission	\$3,000,000
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The estimate has been reduced in this office to \$2,000,000.

## PERMANENT INTERNATIONAL COMMISSION OF THE CONGRESSES OF NAVIGATION.

By act approved June 28, 1902, Congress appropriated the sum of \$3,000 per year for the support and maintenance of the Permanent International Commission of the Congresses of Navigation and for the payment of the actual expenses of the properly accredited national delegates of the United States to the meeting of the congresses and of the Commission.

At the beginning of the fiscal year the United States was represented on the Permanent International Commission of the Congresses of Navigation by Brig. Gen. C. W. Raymond, U. S. Army, retired; Mr. E. L. Corthell, civil engineer; Maj. H. F. Hodges, Corps of Engineers; Maj. J. C. Sanford, Corps of Engineers, and Mr. John Bogart, civil engineer. On the permanent executive committee of that Commission it was represented by General Raymond as the principal representative and Mr. E. L. Corthell as the substitute. The representation on the Commission and on the executive committee has remained unchanged during the year. Major Sanford attended a meeting of the Commission held at Brussels, Belgium, May 6, 1907, at which time various questions were considered and decided pertaining to the proposed Eleventh International Congress of Navigation, to be held at St. Petersburg, Russia, in 1908. Numerous meetings of the American Section of the Permanent International Commission have been held during the year. The section has selected writers for those questions to be considered at the St. Petersburg congress on which American experience was thought to have an important bearing, and has examined and forwarded manuscripts received during the year of papers for this congress, as well as of other papers for publication by the Commission. This office has also collected and forwarded to the general office at Brussels the dues of the American members.

The expenditures during the year from the appropriation made by Congress have been for the expenses of the American Section in attending its meetings and of the delegate to the meeting of the Permanent International Commission, the maintenance of the executive office of the American Section, and for the support and maintenance of the Commission, to which the United States contributes \$1,000 per annum.

## ESTABLISHMENT OF HARBOR LINES.

Under authority given to the Secretary of War in section 11 of the river and harbor act approved March 3, 1899, harbor lines have been established during the past fiscal year at the following localities, under dates as indicated:

Bridgeport Harbor, Connecticut, November 19, 1906; Yellow Mill channel, Bridgeport Harbor, Connecticut, June 5, 1907; East River between East Twenty-sixth and East Twenty-ninth streets, New York City, July 2, 1906; East River at East Twenty-third street, New York, N. Y., July 2, 1906; New York Bay at St. George Ferry terminal, Staten Island, New York, N. Y., March 25, 1907; New York Bay at Red Hook, Brooklyn, N. Y., April 4, 1907; Gravesend Bay, New York, January 29, 1907; Hudson River, west side, near Van Wies Point, below Albany, N. Y., September 10, 1906; Hudson River at

Starbuck and Big Stony islands, Troy, N. Y., November 12, 1906; Hudson River at Hastings-on-the-Hudson, N. Y., April 5, 1907; Passaic River, west bank, near Harrison, N. J., March 30, 1907; Paradise Creek at Norfolk, Va., June 21, 1907; Hampton, Jones, and Herbert creeks, Virginia, August 6, 1906; Edenton Bay at Edenton, N. C., October 27, 1906; Georgetown Harbor, S. C., June 18, 1907; St. Johns River at Hogans Creek, Jacksonville, Fla., January 17, 1907; Hillsboro River at Tampa, Fla., June 17, 1907; Mississippi River at Muscatine, Iowa, February 1, 1907; Mississippi River at Moline, Ill., July 12, 1906; Monongahela River, north side, just above Lock No. 1, March 30, 1907; Monongahela River, between Elizabeth and Lock No. 4, Pennsylvania, July 21, 1906; Monongahela River, between Lock No. 4 and Brownsville, Pa., July 13, 1906; Ohio River, right bank, just below mouth of Allegheny River, Pittsburg Harbor, Pennsylvania, October 1, 1906; Ohio River at Brunot Island, just below Pittsburg, Pa., February 23, 1907; East Twin River at Two Rivers Harbor, Wisconsin, May 11, 1907; Manitowoc River at Manitowoc, Wis., July 13, 1906; Fox River at the city of Green Bay, Wis., September 26, 1906; Illinois River and Peoria Lake at Peoria, Ill., June 13, 1907; Ashtabula Harbor, Ohio, June 21, 1907; harbor at Seattle, Wash., February 28, 1907; Eagle Harbor, Washington, August 17, 1906; Bellingham Harbor, Washington, at I and J streets waterway, July 2, 1906.

#### RULES AND REGULATIONS GOVERNING THE OPENING OF DRAW-BRIDGES.

Section 5 of the river and harbor act of August 18, 1894, provides that it shall be the duty of all persons owning, operating, and tending the drawbridges then built or which might thereafter be built across the navigable rivers and other waters of the United States, to open or cause to be opened the draws of such bridges, under such rules and regulations as in the opinion of the Secretary of War the public interests require, for the passage of vessels and other water craft. Such rules and regulations have been established during the past year by the Secretary of War for certain drawbridges over the following-named waterways:

Bridgeport Harbor, Connecticut; Newark Bay and navigable tributaries, New Jersey (amendment); South River, in Anne Arundel County, Md.; Kent Island Narrows, Maryland; Aquia, Chopawamsic, Quantico, Powells, and Neabsco creeks, Virginia; Tanners Creek, Virginia; certain streams in Louisiana crossed by Morgans Louisiana and Texas Railroad and Steamship Company; Arkansas and White rivers and their tributaries, including Black, Cache, Little, Little Red, and St. Francis rivers; South Fork, Chicago River at Laurel and Ashland streets, also Riverdale Bridge on Calumet River, Chicago, Ill.; Grand River, Michigan.

#### RULES AND REGULATIONS GOVERNING THE NAVIGATION OF CANALS, ETC.

Section 4 of the river and harbor act of August 18, 1894, as amended by section 11 of the river and harbor act of June 13, 1902, delegates to the Secretary of War the duty of prescribing such rules and regulations for the use, administration, and navigation of any or

all canals and similar works of navigation that now are or that hereafter may be owned, operated, or maintained by the United States as in his judgment the public necessity may require; and he is also authorized to prescribe regulations to govern the speed and movement of vessels and other water craft in any public navigable channel which has been improved under authority of Congress, whenever in his judgment such regulations are necessary to protect such improved channels from injury or to prevent interference with the operations of the United States in improving navigable waters or injury to any plant that may be employed in such operations. Such rules and regulations have been established during the past year for the following-named localities:

Portage Lake ship canals, Michigan; St. Clair Flats Canal, Michigan; St. Clair River in the vicinity of Stag Island, Michigan; Detroit River, Michigan; St. Croix River above Lake St. Croix, Minnesota; St. Marys River, Michigan; Kanawha River, West Virginia.

#### STRUCTURES IN THE NAVIGABLE WATERS OF PORTO RICO.

Act of Congress approved June 11, 1906, empowered the Secretary of War, under certain restrictions, to authorize the construction, extension, and maintenance of wharves, piers, and other structures on lands underlying harbor areas and navigable streams and bodies of water in or surrounding Porto Rico and the islands adjacent thereto.

Through a conference between the district officer and the governor of Porto Rico a definite policy has been established and is followed in connection with applications for privileges under this law, several applications having been acted on during the year.

#### BRIDGING NAVIGABLE WATERS OF THE UNITED STATES.

Plans and maps of locations of the following bridges proposed to be erected under the authority of special acts of Congress have been examined with a view to protection of the interests of navigation and have been approved by the Secretary of War, as provided by the acts, and the local engineer officers have been furnished copies of the instruments of approval and drawings showing plans and locations and charged with the supervision of the construction of the bridges, so far as necessary, to see that they are built in accordance with the approved plans:

*Bridge of the Pierre and Fort Pierre Bridge Railway Company over Missouri River at Pierre, S. Dak.*—Authority for the construction of a bridge at this point was granted by act of Congress approved May 17, 1886. Plans and map of location were approved July 14, 1907.

*Bridge of the Back River Bridge Company over west or smaller channel of Ohio River (Back River) between Wheeling Island, West Virginia, and Ohio shore.*—Plans and map of location of a bridge at this place under authority of act of Congress approved June 25, 1906, were approved July 14, 1906.

*Bridge of the Northampton and Halifax Bridge Company over Roanoke River near Weldon, N. C.*—Plans and map of location of a



bridge proposed to be built at this place under authority of an act of Congress approved May 16, 1906, were approved July 30, 1906.

*Bridge of Sunflower County, Miss., over Sunflower River at Lehton, Miss.*—Plans and map of location of a bridge to be built at this place under authority of act of Congress approved June 28, 1906, were approved August 15, 1906.

*Bridge of the Chicago, Milwaukee and St. Paul Railway Company over the Missouri River between Walworth and Dewey counties, S. Dak.*—Plans and map of location of a bridge to be built at this place under authority of act of Congress, approved April 2, 1906, were approved August 23, 1906.

*Bridge of Washington County, Miss., over Yazoo River at Belzoni.*—Plans and map of location of a bridge to be built at this place under authority of act of Congress approved April 13, 1906, were approved August 23, 1906.

*Bridge of Jefferson County, Ark., over Arkansas River at Pine Bluff.*—Plans and map of location of a bridge to be built at this place under authority of act of Congress approved March 5, 1906, were approved August 31, 1906.

*Bridge of the Delta Southern Railway over Big Sunflower River in Sharkey County, Miss.*—Plans and location of a bridge at this place, to be built under authority of act of Congress approved January 28, 1905, were approved February 12, 1906. Modified plans were approved October 25, 1906.

*Bridge of the Chicago, Milwaukee and St. Paul Railway Company over Columbia River between Douglas and Kittitas counties, Wash.*—Plans and map of location for a bridge proposed to be built at this place, under authority of act of Congress approved April 9, 1906, were approved October 27, 1906.

*Bridge of the Portland and Seattle Railway Company over Columbia River and Oregon Slough (of Columbia River) at Vancouver, Wash.*—Plans and map of location of a bridge at this place under authority of act of Congress approved December 21, 1905, were approved February 12, 1906, and were slightly modified November 19, 1906.

*Bridge of the South and Western Railroad Company over Clinch River near St. Paul, Va.*—Authority for the construction of a bridge at this place was granted by act of Congress approved May 12, 1906. Plans and map of location were approved December 4, 1906.

*Bridge of the South and Western Railroad Company across the South Fork of Holston River near Kingsport, Tenn.*—Authority for the construction of a bridge at this place was granted by act of Congress approved May 12, 1906. Plans and map of location were approved December 4, 1906.

*Bridge of South and Western Railroad Company over the North Fork of Holston River near Kingsport, Tenn.*—Authority for the construction of a bridge at this place was granted by act of Congress approved May 12, 1906. Plans and map of location were approved December 4, 1906.

*Bridges of the Chicago, Milwaukee and St. Paul Railway Company over Yellowstone River near Tusler, Terry, and Miles City, Mont.*—Plans and maps of location for bridges proposed to be built at these points under authority of act of Congress approved April 2, 1906, were approved December 4, 1906.



*Bridge of the South and Western Railroad Company over Clinch River near milepost 55.3 in Scott County, Va.*—Authority for the construction of a bridge at this place was granted by act of Congress approved May 12, 1906. Plans and map of location were approved December 5, 1906.

*Bridge of the South and Western Railroad Company over Clinch River near Starnes Bend, Scott County, Va.*—Authority for the construction of a bridge at this place was granted by act of Congress approved May 12, 1906. Plans and map of location were approved December 5, 1906.

*Bridge of the Kensington and Eastern Railroad Company over Calumet River, near the forks, in Cook County, Ill.*—Authority for construction of this bridge was granted by act of Congress approved February 7, 1905, as amended by act approved March 5, 1906. Plans and map of location were approved December 18, 1906.

*Bridge of the Evansville, Mount Carmel and Northern Railway over Wabash River near Mount Carmel, Ill.*—Plans and map of location of a bridge proposed to be built at this place, under authority of act of Congress approved June 30, 1906, were approved December 22, 1906.

*Bridge of the Rainy River Bridge Company over Rainy River at Pithers Point, in Itaska County, Minn.*—Plans and map of location of a bridge at this place, under authority of an act of Congress approved April 6, 1906, were approved January 8, 1907.

*Bridge of the Parkersburg and Ohio Bridge Company over Ohio River at Parkersburg, W. Va.*—Authority for the construction of this bridge was granted by act of Congress approved December 17, 1872, as amended by act approved February 14, 1883. Plans for this bridge were considered by a Board of Engineers as required by law and were approved January 9, 1907.

*Bridge of the Alabama, Tennessee and Northern Railroad Company over Tombigbee River at Stones Ferry, Tenn.*—The construction of this bridge is authorized by act of Congress approved January 14, 1907. Plans and map of location were approved January 25, 1907.

*Bridge of the Kansas City, St. Joseph and Excelsior Springs Railway Company over Missouri River at Grand avenue, Kansas City, Mo.*—Plans and map of location for the construction of a bridge at this locality, under authority of act of Congress approved May 16, 1906, were approved February 11, 1907.

*Bridge of the Chicago, Lake Shore and South Bend Railway Company over Calumet River near East Chicago and Gary, Ind.*—The construction of this bridge was authorized by act of Congress approved February 5, 1907. Plans and map of location were approved February 16, 1907.

*Bridge of the Mobile Railway and Dock Company over a portion of Mobile Bay, from Cedar Point to Dauphin Island, Ala.*—Plans and map of location of a bridge proposed to be built at this place, under authority of act of Congress approved February 5, 1906, were approved February 23, 1907.

*Bridge of Lake County, Ind., over Calumet River at Columbia avenue in the city of Hammond, Ind.*—Authority for the construction of a bridge at this place was authorized by act of Congress approved February 5, 1907. Plans and map of location were approved March 12, 1907.

*Bridge of the Kanawha Bridge and Terminal Company over Kanawha River at Charleston, W. Va.*—Plans and map of location of a bridge to be constructed under authority of act of Congress approved March 3, 1887, were approved April 5, 1907.

*Bridge of the Bellaire, Benwood and Wheeling Bridge Company over Ohio River at Bellaire, Ohio, and Benwood, W. Va.*—Plans for a bridge at this place were approved June 14, 1901. The plans were reapproved November 29, 1905, and plans in lieu thereof were approved April 20, 1906, and reapproved April 24, 1907.

*Bridge of the Albany Railroad Bridge Company over Mississippi River at Clinton, Iowa, by the Chicago and North-Western Railway Company.*—The reconstruction of the bridge at this place was authorized by act of Congress approved February 6, 1907. Plans for its reconstruction were approved May 4, 1907.

*Bridges of Davidson County, Tenn., over Cumberland River at Sparkman and Jefferson streets, Nashville, Tenn.*—Plans for the construction of these two bridges, under authority of act of Congress approved April 24, 1906, as amended by act of February 25, 1907, were approved May 8, 1907.

*Bridge of the Minneapolis, St. Paul and Sault Ste. Marie Railway Company over the Mississippi River near Royalton, Minn.*—Authority for the construction of a bridge at this place was granted by act of Congress approved February 1, 1907. Plans and map of location were approved May 8, 1907.

*Bridge of the Kentucky and West Virginia Bridge Company over Tug Fork of Big Sandy River at Williamson, W. Va.*—Authority for the construction of a bridge at this place was granted by act of Congress approved February 27, 1907. Plans and map of location were approved May 21, 1907.

*Bridge of Allegheny County, Pa., over Allegheny River at Oakmont and Hulton Ferry.*—Authority for the construction of a bridge at this place was granted by act of Congress approved January 12, 1907. Plans and map of location were approved June 11, 1907.

*Bridge of the Monongahela Connecting Railroad Company across Monongahela River at Pittsburg, Pa.*—Authority for the construction of a bridge at this place was granted by act of Congress approved June 28, 1906. Plans and map of location were approved June 11, 1907.

*Bridge of the Norfolk and Western Railroad Company over Potomac River at Shepherdstown, W. Va.*—Plans and map of location for a bridge to be built at this place under authority of act of Congress approved February 5, 1907, were approved June 26, 1907.

Under the provisions of section 9 of the river and harbor act approved March 3, 1899, bridges may be built over navigable waters entirely within the limits of any State, under authority of legislative enactment of such State, when the plans and locations of the structures are approved by the Secretary of War. Plans and maps of locations of the following bridges proposed to be erected under these provisions have been examined with a view to protection of the interests of navigation and have been approved by the Secretary of War, and the local engineer officers have been furnished copies of the drawings and instruments of approval and charged with the supervision of construction of the bridges, so far as necessary, to see that they are built in accordance with the approved plans:

*Bridge of the Virginia and Carolina Coast Railroad Company over Mackeys Creek at Mackeys Ferry, N. C.*—Plans and map of location were approved July 11, 1906.

*Bridge of the Bay Counties Railway Company over Tolay Creek, in Sonoma County, Cal.*—Plans and map of location were approved July 14, 1906.

*Bridge of the Bay Counties Railway Company over San Rafael Creek, in Marin County, Cal.*—Plans for the construction of a bridge at this locality were approved July 14, 1906.

*Bridge of the Bay Counties Railway Company over Gallinas Creek, in Marin County, Cal.*—Plans and map of location were approved July 14, 1906.

*Bridge of the Bay Counties Railway Company over Sonoma Creek, in Sonoma County, Cal.*—Plans and map of location were approved July 16, 1906.

*Bridge of the Bay Counties Railway Company over Novato Creek, in Marin County, Cal.*—Plans and map of location were approved July 16, 1906.

*Bridge of Lafayette and Suwanee counties, Fla., over the Suwanee River at Branford, Fla.*—Plans and map of location of a bridge to be built at this place were approved July 16, 1906.

*Bridge of the Chicago, Milwaukee and St. Paul Railway Company over Puyallup River near Tacoma, Wash.*—Plans and map of location were approved July 16, 1906.

*Bridge of the Minneapolis and Rainy River Railway Company over Big Fork River, in Itaska County, Minn.*—Plans and map of location were approved July 19, 1906.

*Bridge of the Vicksburg, Shreveport and Pacific Railway Company over the Ouachita River at Monroe, La.*—Plans for the reconstruction of this bridge were approved July 19, 1906.

*Bridges of the Chicago Junction Railway Company over South Fork of South Branch of Chicago River at Iron street and Center avenue and temporary bridge at West Thirty-ninth street, Chicago, Ill.*—Plans and maps of location of these bridges were approved by the Secretary of War July 20, 1906.

*Bridge of the Elizabeth River Railroad Company over New Mill Creek, in Norfolk County, Va.*—Plans and map of location were approved July 20, 1906.

*Bridge of Hudson County, N. J., over Hackensack River at Jersey City.*—Plans for reconstruction of this bridge were approved July 20, 1906.

*Bridge of the Washington and Vandemere Railroad Company over South Creek, near Aurora, N. C.*—Plans and map of location were approved July 26, 1906.

*Bridge of Essex and Hudson counties, N. J., over Passaic River at Passaic and East Passaic.*—Plans for reconstruction of this bridge and for a temporary foot bridge were approved July 26, 1906.

*Bridge of Braxton County, W. Va., over Elk River at Frametown, W. Va.*—Plans for the construction of this bridge were approved July 31, 1906.

*Bridge of the Beaumont, Sour Lake and Western Railway Company over Trinity River, Texas.*—Plans and map of location were approved August 7, 1906.

*Bridge of the Bowie Lumber Company (Limited) over Bayou Cabanosso (Grand Bayou), La.*—Plans and map of location were approved August 7, 1906.

*Bridge of the Oregon Electric Railway Company over Willamette River near Wilsonville, Oreg.*—Plans and map of location were approved August 8, 1906.

*Bridge of the Mobile and Ohio Railroad Company over Okaw (Kaskaskia) River near Baldwin, Ill.*—Plans for rebuilding the existing bridge at this place were approved May 17, 1906, and new plans in lieu of those approved May 17, 1906, were approved August 8, 1906.

*Bridge of the Southern Railway Company over Holston River at Brabsons Ferry, Tenn.*—Plans and map of location were approved August 10, 1906.

*Bridge of Union Parish over Bayou D'Arbonne at Cox Ferry, La.*—Plans and map of location were approved August 10, 1906.

*Bridge of the Colorado Southern, New Orleans and Pacific Railroad Company over the Atchafalaya River near Melville, La.*—Plans and map of location of a bridge proposed to be built at this place were approved August 15, 1906.

*Bridge of the Morgans Louisiana and Texas Railroad and Steamship Company over Lake Bijeau, in St. Martin Parish, La.*—Plans and map of location of a bridge proposed to be built at this place were approved August 16, 1906.

*Bridge of the Morgans Louisiana and Texas Railroad and Steamship Company over Bayou des Ourse, in St. Martin Parish, La.*—Plans and map of location of a bridge proposed to be built at this locality were approved August 17, 1906.

*Bridge of the Central New England Railway Company over the Hudson River at Poughkeepsie, N. Y.*—Plans for the reconstruction of this bridge were approved by the Secretary of War August 17, 1906.

*Bridge of the Morgans Louisiana and Texas Railroad and Steamship Company over Bayou Choctaw, in West Baton Rouge Parish, La.*—Plans and map of location were approved August 17, 1906.

*Bridge of the city of Everett, Wash., over Snohomish River, at Everett.*—Plans for reconstruction of this bridge were approved August 21, 1906.

*Bridge of the Los Angeles Dock and Terminal Company over Ceritos Slough at Long Beach, Cal.*—Plans and map of location for a bridge at this place were approved August 22, 1906.

*Bridges of George I. Hammond et al. across the North and South forks of Kentucky River at Beattyville, Ky.*—Plans and map of locations were approved August 29, 1906.

*Bridge of the city of Peoria, Ill., over Illinois River at Peoria (lower free wagon bridge).*—Plans for this bridge were approved August 30, 1906.

*Bridge of the Norfolk and Southern Railroad Company over Pungo River at Bellhaven, N. C.*—Plans and map of location of a bridge proposed to be built at this place were approved August 31, 1906.

*Bridge of the Southern Pacific Company over Newark Slough near Potrero Point, San Francisco Bay, California.*—Plans and map of

location of a bridge to be built at this place were approved September 6, 1906.

*Bridge of the Long Island Railroad Company over Fosters Meadow Canal, New York.*—Plans for this bridge were approved September 8, 1906.

*Bridge of Venango County, Pa., over Allegheny River at Kennerdell.*—Plans for the construction of this bridge were approved January 13, 1903. Plans in lieu thereof were approved June 13, 1906, and September 13, 1906.

*Bridge of Jones County, N. C., over Trent River, at Pollokville, N. C.*—Plans for the reconstruction of this bridge were approved September 13, 1906.

*Bridge of the Delta Southern Railway Company across Bear Creek, between Sunflower and Washington counties, Miss.*—Plans for the construction of this bridge were approved September 27, 1906.

*Bridge of the Seattle Electric Company over East and West waterways of Elliott Bay at Seattle and West Seattle, Wash.*—Plans and map of location were approved September 27, 1906.

*Bridge of Craven County, N. C., over Neuse River at or near Maple Cypress, N. C.*—Plans and map of location were approved October 2, 1906.

*Bridge of Manatee County, Fla., over Braden Creek.*—Plans and map of location of a bridge proposed to be built at this place were approved October 11, 1906.

*Bridge of the Chicago and North-Western Railway Company over the North Branch of Chicago River, near Kinzie street, Chicago, Ill.*—Plans for the reconstruction of this bridge were approved October 11, 1906.

*Bridge of the Chicago, Milwaukee and St. Paul Railway Company over the North Branch of Chicago River, near Kinzie street, Chicago, Ill.*—Plans for the construction of a bridge at this place were approved October 11, 1906.

*Bridge of the city of Chicago across the North Branch of Chicago River, near Kinzie street, Chicago, Ill.*—Plans for reconstruction of this bridge were approved October 12, 1906.

*Bridge of Lafayette and Suwanee counties, Fla., over the Suwanee River at Lurayville, Fla.*—Plans and map of location of a bridge to be built at this locality were approved October 12, 1906.

*Two bridges of the Brooklyn Rapid Transit Company over Coney Island Creek, at Coney Island, N. Y.*—Plans for reconstructing these two bridges were approved October 13, 1906.

*Bridge of the Munfordville Bridge Company over Green River at Munfordville, Ky.*—Plans and map of location of a bridge to be built at this locality were approved October 25, 1906.

*Bridge of the city of Aberdeen over Elliott Slough, at Aberdeen, Wash.*—Plans and map of location for this bridge were approved October 26, 1906.

*Bridge of the Tampa Terminal Company over Hillsboro Bay at Tampa, Fla.*—Plans and map of location were approved October 26, 1906.

*Bridge of Laporte County, over Trail Creek, at Franklin street, Michigan City, Ind.*—Plans for the reconstruction of this bridge were approved October 27, 1906.

*Bridge of the New York, New Haven and Hartford Railroad Company over Niantic River, at East Lyme, Conn.*—Plans for the construction of a bridge at this place were approved October 30, 1906.

*Bridge of the city of Appleton, Wis., across United States (Fox River) canal at John street.*—Plans for reconstruction of this bridge were approved November 3, 1906.

*Bridge of Greene County, Miss., over Chickasahay River at Avera's Crossing, Miss.*—Plans and map of location of a bridge to be built at this place were approved November 3, 1906.

*Bridge of the Virginia and Carolina Coast Railroad Company over Bay River near Bayboro, N. C.*—Plans and map of location were approved November 3, 1906.

*Bridge of the Atlantic City and Ocean City Railroad Company over Great Egg Bay, between Somers Point and Ocean City, N. J.*—Plans and map of location were approved November 3, 1906.

*Bridge of the New York, New Haven and Hartford Railroad Company over West River at New Haven, Conn.*—Plans for the reconstruction of this bridge were approved November 5, 1906.

*Bridge of the San Pedro, Los Angeles and Salt Lake Railroad Company over Cerritos Slough at Long Beach, Cal.*—Plans for the reconstruction of this bridge were approved November 7, 1906.

*Bridge of the New York, New Haven and Hartford Railroad Company over Duck River at Lyme, Conn.*—Plans for the reconstruction of this bridge were approved November 8, 1906.

*Bridge of the Southern Pacific Company across southern part of San Francisco Bay, at Dumbarton or Potrero Point, Cal.*—Plans for the construction of this bridge were approved November 14, 1906.

*Bridge of the city of New London, Conn., over Winthrop Cove at Crystal avenue.*—Plans for rebuilding existing bridge were approved November 14, 1906.

*Bridge of the counties of Nansemond and Southampton over Blackwater River at South Quay, Va.*—Plans and map of location were approved November 14, 1906.

*Bridge of the John L. Roper Lumber Company over Trent River at Polloksville, N. C.*—Plans and map of location of a bridge proposed to be constructed at this place were approved by the Secretary of War November 20, 1906.

*Bridge of the city of Chicago, Ill., over the North Branch Canal of Chicago River at North Halsted street.*—Plans and map of location were approved June 23, 1905. Modified plans were approved November 20, 1906.

*Bridge of the Atlantic Shore Line Railway Company over Cape Neddick River in the town of York, Me.*—Plans and map of location of a bridge at this place were approved November 21, 1906.

*Bridge of the Chicago, Milwaukee and St. Paul Railway Company over Burnhams Canal, Milwaukee, Wis.*—Plans for the reconstruction of this bridge were approved November 23, 1906.

*Bridge of the Holston River Railway Company over Holston River near Millers Island, about 3 miles below Surgoinsville, Tenn.*—Plans and map of location of a bridge to be built at this place were approved November 28, 1906.

*Bridge of the city of Charleston, W. Va., over Elk River at Virginia street, Charleston, W. Va.*—Plans for the reconstruction of this bridge were approved December 3, 1906.

*Bridges of the Norfolk and Southern Railroad Company over Albemarle Sound and Johnson and Mackeys creeks, N. C.*—Plans and maps of location of bridges proposed to be built at these places were approved December 6, 1906.

*Bridge of Southern Railway Company over Caney Fork River at Buffalo Valley, Tenn.*—Plans for reconstruction of this bridge were approved December 11, 1906.

*Bridges of the Virginia and Carolina Coast Railroad Company over Smiths Creek at Oriental, and Adams Creek at Winthrop, N. C.*—Plans and map of location were approved December 12, 1906.

*Bridge of the Portland and Seattle Railway Company over Columbia Slough (of Columbia River) at Vancouver, Wash.*—Plans and map of location were approved December 12, 1906.

*Bridge of the New York Central and Hudson River Railroad Company over Doodletown Bight, or Creek, N. Y.*—Plans for the reconstruction of this bridge were approved December 13, 1906.

*Bridge of the Oregon and Washington Railroad Company over Puyallup River near Tacoma, Wash.*—Plans and map of location were approved December 21, 1906.

*Bridge of the Baltimore and Ohio Railroad Company over Grand River at Painesville, Ohio.*—Plans for the reconstruction of this bridge were approved December 22, 1906.

*Bridge of the New York, New Haven and Hartford Railroad Company over Winthrop Cove at New London, Conn.*—Plans for reconstruction of an existing bridge were approved January 2, 1907.

*Bridge of the Ensley Southern Railway Company over Locust Fork of Black Warrior River near Short Creek, Ala.*—Plans and map of location were approved January 5, 1907.

*Bridge of Messrs. Shadle and Auchmuty over Elk River near Yankeedam, W. Va.*—Plans and map of location were approved January 11, 1907.

*Bridge of the Kansas City Belt Railway Company over Kaw (Kansas) River at Kansas City, Kans.*—Plans for reconstruction of this bridge were approved September 19, 1905, the approval being subsequently amended by instrument dated December 2, 1905, and modified plans were approved January 11, 1907.

*Bridge of the city of Tacoma over the City waterway at South Eleventh street, Tacoma, Wash.*—Plans for the reconstruction of this bridge were approved January 11, 1907.

*Bridge of Perry County, Miss., over Leaf River near Beaumont, Miss.*—Plans and map of location were approved January 16, 1907.

*Bridge of the city of Toledo over the Maumee River at Cherry and Main streets, Toledo, Ohio.*—Plans for the reconstruction of this bridge were approved January 22, 1907.

*Bridge of the Northern Pacific Railway Company over St. Louis Bay between Duluth, Minn., and Superior, Wis.*—Plans for the reconstruction of this bridge were approved January 22, 1907.

*Bridge of the Tampa Northern Railroad Company over Hillsboro River, Florida, about 11 miles above its mouth.*—Plans and map of location were approved January 25, 1907.

*Bridges of the Tampa Northern Railroad Company over an inlet of Hillsboro Bay, near Tampa, Fla.*—Plans and map of location of five bridges were approved January 28, 1907.

*Bridge of the city of Milwaukee, Wis., over South Menominee Canal at First avenue.*—Plans for rebuilding an existing structure



were approved July 26, 1905, and plans in lieu thereof were approved January 31, 1907.

*Bridge of Delaware County, Pa., over Darby Creek at Media.*—Plans and map of location were approved January 31, 1907.

*Bridges of the Galveston, Harrisburg and San Antonio Railway Company over Clear Creek and Dickinson Bayou, Texas.*—Plans for the reconstruction of these bridges were approved January 31, 1907.

*Bridge of the Colorado Southern, New Orleans and Pacific Railroad Company over Bayou Courtableau in St. Landry Parish, La.*—Plans and map of location were approved May 25, 1906; modified plans were approved February 2, 1907.

*Bridge of the New York Central and Hudson River Railroad Company over Wappinger Creek at New Hamburg, N. Y.*—Plans for the construction of this bridge were approved February 7, 1907.

*Bridge of the Portland and Seattle Railway Company over Klickitat River, Washington.*—Plans and map of location were approved February 9, 1907.

*Bridge of the Portland and Seattle Railway Company over Little White Salmon River, Washington.*—Plans and map of location were approved February 9, 1907.

*Bridge of the Portland and Seattle Railway Company over White Salmon River, Washington.*—Plans and map of location were approved February 9, 1907.

*Bridge of the county of La Salle and towns of Deer Park and Utica, Ill., over the Illinois River at Utica.*—Plans and map of location were approved February 16, 1907.

*Bridge of the Illinois and Northern Railway Company over the West Fork, South Branch, Chicago River, at Central Park avenue, Chicago, Ill.*—Plans for the reconstruction of this bridge were approved February 23, 1907.

*Bridge of the Portland and Seattle Railway Company over Wind River, Washington.*—Plans and map of location were approved February 26, 1907.

*Bridge of the Lake Charles and Northern Railroad Company over Calcasieu River in Calcasieu Parish, La.*—Plans and map of location were approved February 26, 1907.

*Bridge of the Long Island Railroad Company over Fosters Meadow (Hook Creek) Canal, New York.*—Plans and map of location were approved February 26, 1907.

*Bridge of the Baltimore, Chesapeake and Atlantic Railway Company over Sinepuxent Bay at Ocean City, Md.*—Plans for the reconstruction of this bridge were approved February 28, 1907.

*Bridge of the Baltimore and Ohio Railroad Company over Ridley Creek near Chester Pa.*—Plans for the reconstruction of this bridge were approved March 2, 1907.

*Bridge of the city of Manitowoc, Wis., over Manitowoc River at Park and Center streets.*—Plans for this bridge were approved March 4, 1907.

*Bridge of the Carthage and Granville Bridge Company over Caney Fork River at Ballards Ferry, Tennessee.*—Plans and map of location were approved March 6, 1907.

*Bridge of Skagit County over Swinomish Slough near La Conner, Wash.*—Plans and map of location were approved March 6, 1907.



*Bridge of Georgetown and Williamsburg counties, S. C., across Mingo (or Black Mingo) Creek at Mingo (or Black Mingo) Bridge.*—Plans and map of location were approved March 12, 1907.

*Bridge of Pacific County over Ellis Slough near Raymond, Wash.*—Plans and map of location were approved March 14, 1907.

*Bridge of the Parkersburg and South Side Bridge Company over Little Kanawha River at Parkersburg, W. Va.*—Plans and location of a bridge at this place were approved March 15, 1907.

*Bridge of Greene County over Chickasaw River at Millers Ferry, Mississippi.*—Plans and map of location were approved March 18, 1907.

*Bridge of William H. May et al. over Levisa Fork of Big Sandy River at Prestonburg, Ky.*—Plans and map of location were approved March 18, 1907.

*Bridge of the city of Chicago over the West Arm of the South Fork of the South Branch of the Chicago River at Ashland avenue, Chicago, Ill.*—Plans and map of location were approved March 20, 1907.

*Bridge of Iberville Parish, La., over Bayou Plaquemine at Plaquemine, La.*—Plans for the reconstruction of this bridge were approved March 25, 1907.

*Bridge of Fayette County, Pa., over Cheat River at Point Marion and Springhill.*—Plans and map of location were approved March 26, 1907.

*Bridge of Great Northern Railway Company (interstate bridge) over St. Louis Bay, between Rices Point and Connors Point, Duluth Harbor, Minnesota.*—Plans for reconstruction of this bridge were approved April 1, 1907.

*Bridge of St. Tammany Parish over Bayou Vincent at Slidell, La.*—Plans and map of location were approved April 3, 1907.

*Bridge of Chehalis County over Humptulips River, Washington.*—Plans and map of location were approved April 3, 1907.

*Bridge of Chehalis County over Higgins Slough, Washington.*—Plans and map of location were approved April 3, 1907.

*Bridge of Lafayette Parish, La., over Bayou Vermilion at Dormas Broussard Crossing.*—Plans for the reconstruction of this bridge were approved April 4, 1907.

*Bridge of the Beaverton and Willsburg Railroad Company over Willamette River at Oswego, Oreg.*—Plans and map of location were approved April 5, 1907.

*Bridge of York County, Me., over York River at York.*—Plans and map of location were approved April 11, 1907.

*Bridge of the Big Fork and International Falls Railway Company over Little Fork River near Little Fork, Minn.*—Plans and map of location were approved April 16, 1907.

*Bridge of the Pittsburgh, Fort Wayne and Chicago Railway Company over the South Branch of Chicago River at Stewart avenue, Chicago, Ill.*—Plans for the reconstruction of a bridge at this place were approved April 17, 1907.

*Bridges of the Northern Pacific Railway Company over Hoquiam River at Hoquiam, Wash., and over Wishka River at Aberdeen, Wash.*—Plans for the reconstruction of these bridges were approved April 20, 1907.

*Bridge of the Northern Electric Company over Sacramento River near Chico Landing, California.*—Plans and map of location were approved April 29, 1907.

*Bridge of the Oregon and Washington Railroad Company over Lake River near Ridgefield, Wash.*—Plans and map of location were approved May 3, 1907.

*Bridge of the Oregon and Washington Railroad Company over Cowlitz River near Olegua, Wash.*—Plans and map of location were approved May 3, 1907.

*Bridge of the Oregon and Washington Railroad Company over Lewis River near Woodland, Wash.*—Plans and map of location were approved May 4, 1907.

*Bridge of the Inman-Poulsen Logging Company over Coal Creek Slough near the mouth of Coal Creek, Washington.*—Plans and map of location were approved May 4, 1907.

*Bridge of the Boston and Maine Railroad Company over Piscataqua River at Dover Point, N. H.*—Plans for the reconstruction of this bridge were approved May 6, 1907.

*Bridge of Lee County, Fla., over Caloosahatchee River at Denaud.*—Plans and map of location were approved May 8, 1907.

*Bridge of the Memphis, Paris and Gulf Railroad Company over Little River near Folmina (White Cliffs), Ark.*—Plans and map of location were approved May 9, 1907.

*Bridge of the town of Southport over Deckers Cove, Maine.*—Plans and map of location were approved May 10, 1907.

*Bridge of the East Carolina Railway over Contentnia Creek at Hookerton, N. C.*—Plans and map of location for a bridge proposed to be built at this place were approved May 11, 1907.

*Bridges of Anne Arundel County, Md., over Traceys Creek and Rock Hole Creek, at the head of Herring Bay, in vicinity of Traceys Landing.*—Plans and map of locations of bridges proposed to be built at these places were approved May 11, 1907.

*Bridge of the Erie Railroad Company (New York and Greenwood Lake Railway Company) over Hackensack River near Snake Hill, N. J.*—Plans for the reconstruction of this bridge were approved May 15, 1907.

*Bridge of Barnstable County over Bass River at Yarmouth and Dennis, Mass.*—Plans for the reconstruction of a bridge at this place were approved May 15, 1907.

*Bridge of Iberia Parish over Bayou Teche at Sarah plantation, Louisiana.*—Plans and map of location were approved May 21, 1907.

*Bridge of J. N. Pharr & Sons (Limited) across Bayou Teche at Sorrell plantation, Louisiana.*—Plans and map of location were approved May 22, 1907.

*Bridge of Woodruff County, Ark., over Cache River at Cottonplant, Ark.*—Plans and map of location of this bridge were approved May 22, 1907.

*Bridge of the George Orbin Bridge Company over Chartiers Creek at McKees Rocks, Pa.*—Plans and map of location of a bridge at this place were approved May 27, 1907.

*Bridge of the city of Racine, Wis., over Root River at Herrick and Lafayette avenues.*—Plans and map of location were approved May 28, 1907.

*Bridge of Duval County over McGirts Creek, Florida.*—Plans and map of location were approved May 28, 1907.

*Bridge of H. Shelby Sanders over Bayou Teche at Bayside plantation, near Jeanerette, La.*—Plans and map of location were approved June 1, 1907.

*Bridge of Suffolk County, N. Y., over the Shinnecock and Peconic Canal.*—Plans and map of location were approved June 11, 1907.

*Bridge of the Baltimore and Ohio Railroad Company over Susquehanna River at Havre de Grace, Md.*—Plans for rebuilding an existing structure were approved June 19, 1907.

*Bridge of the Grays Harbor and Puget Sound Railway Company over Chehalis River at Aberdeen, Wash.*—Plans and map of location were approved June 20, 1907.

*Bridge of the Georgia and Florida Railway over Altamaha River, Georgia.*—Plans and map of location were approved June 28, 1907.

*Bridge of Pacific County, Wash., across Wilson Creek at Willapa, Wash.*—Plans and map of location were approved June 28, 1907.

#### BRIDGES OBSTRUCTING NAVIGATION.

Under the requirements of section 18 of the river and harbor act approved March 3, 1899, the Secretary of War notified the persons, corporations, or associations owning or controlling certain bridges obstructing navigation, after giving them a reasonable opportunity to be heard, to so alter said bridges as to render navigation through or under them reasonably free, easy, and unobstructed, specifying in the notice the alterations required to be made and prescribing a reasonable time in which to make them, as follows:

*Bridge of the city of Ludington, Mich., over a channel of Ludington Harbor at Washington street.*—Notice dated August 10, 1906, served on the mayor August 20, 1906. Specified alterations to be completed on or before June 1, 1907.

*Bridge of the Rutland Railroad Company over a channel in Lake Champlain known as "The Gut," between Thromps Point, South Hero Island, and Bow Arrow Point, North Hero Island, Vermont.*—Notice dated August 9, 1906, served on the company August 17, 1906. Specified alternative alterations to be completed on or before December 31, 1907, or within four months from date of service of notice, respectively.

*Bridge of the New York Central and Hudson River Railroad Company over Wappinger Creek, New York.*—Notice dated October 12, 1906, served on the company October 22, 1906. Specified alterations to be completed on or before six months from date of service of notice.

*Bridge of the Williamsport Bridge Company and Washington and Allegheny counties, Pa., over Monongahela River at Monongahela, Pa.*—Notices dated October 10, 1906, served on the company October 15, 1906, and on the county commissioners October 16 and 17, 1906, respectively. Specified alterations to be completed on or before two years from date of service of notice.

*Bridge of the Baltimore and Ohio Railroad Company (Parkersburg Branch Railroad Company) over Ohio River at Parkersburg, W. Va., and Belpre, Ohio.*—Notice dated November 7, 1906, served on the company November 12, 1906. Specified alterations to be completed on or before December 1, 1908.

*Bridge of the San Pedro, Los Angeles and Salt Lake Railroad Company over San Gabriel (Los Angeles) River at Long Beach, Cal.*—Notice dated November 28, 1906, served on the company December 11, 1906. Specified alterations to be completed on or before nine months from date of service of notice.

*Bridge of the Seaboard Air Line Railway Company over Savannah River at Hutchinson Island, Savannah, Ga.*—Notice dated January 5, 1907, served on the first vice-president February 21, 1907. Specified alterations to be completed within eighteen months from date of service of notice. This time was subsequently extended to July 1, 1909.

*Bridge of the Sturgeon Bay Bridge Company and the Ahnapee and Western Railway Company over Sturgeon Bay at Sturgeon Bay, Wis.*—Notices dated March 25, 1907, served on the companies April 8 and 16, 1907, respectively. Specified alterations to be completed on or before one year from date of service of notice.

*Bridge of Salem County, N. J., over Salem Creek at Course Landing.*—Notice dated April 2, 1907, served on the board of chosen freeholders April 13, 1907. Specified alterations to be completed on or before July 1, 1908.

*Bridge of the New York, Susquehanna and Western Railroad Company over Overpeck Creek at Ridgefield Park, N. J.*—Notice dated May 25, 1907, served on the company May 31, 1907. Specified alterations to be completed on or before July 1, 1907.

*Bridge of the city of Green Bay, Wis., over Fox River at Mason street.*—Notice dated June 24, 1907, served on the mayor July 23, 1907. Specified alterations to be completed on or before March 15, 1910.

#### STRUCTURES OTHER THAN BRIDGES IN THE NAVIGABLE WATERS OF THE UNITED STATES.

Pursuant to the provisions of sections 9 and 10 of the river and harbor act of March 3, 1899, and of certain special acts of Congress, numerous applications for permission to build structures of various kinds other than bridges (such as dams, wharves, dolphins, booms, weirs, etc.) in the navigable waters of the United States have been examined with a view to the protection of navigation interests.

Upon the recommendation of the Chief of Engineers permits have been granted by the Secretary of War for the erection of a number of such structures, but specific reference is not deemed necessary except in the following cases:

*Dam of the Capital City Improvement Company across Missouri River in vicinity of Buck Rapids, Montana.*—Construction of this dam was authorized by act of Congress approved April 12, 1906. Plans and map of location were approved August 17, 1906.

*Dam of the State of Massachusetts across Mystic River near Cra-dock Bridge, Medford.*—Under the provisions of section 9 of the river and harbor act of March 3, 1899, plans for a dam at this place were approved September 6, 1906.

*Dam of the St. Cloud Electric Power Company across Mississippi River at Augusta, Minn.*—Construction of this dam was authorized by act of Congress approved June 28, 1906. Plans and map of location were approved February 2, 1907.

*Dam of the Sauk Rapids Water Power Company in Mississippi River at Sauk Rapids, Minn.*—Construction of this dam was authorized by act of Congress approved February 26, 1904, as amended by act of March 2, 1907. Plans and map of location were approved February 11, 1907.

*Dam of Samuel S. Davis in Rock River at Carrs and Vandruff's islands, Ill.*—Construction of this dam was authorized by act of Congress approved May 1, 1906. Plans and map of location were approved February 16, 1907.

*Dam of the Choctawhatchee Power Company in Choctawhatchee River near Newton, Ala.*—Construction of this dam was authorized by act of Congress approved April 5, 1906. Plans and map of location were approved April 2, 1907.

*Dam of the Susquehanna Power Company across Susquehanna River near Conowingo, Md.*—Under the provisions of section 9 of the river and harbor act of March 3, 1899, plans for a dam at this place were approved April 9, 1907.

*Dam of the Berrien Springs Power and Electric Company across St. Joseph River near Berrien Springs, Mich.*—Construction of this dam was authorized by act of Congress approved April 5, 1906. Plans and map of location were approved April 19, 1907.

*Dam of the Beltrami Electric Light and Power Company (successor to Kirby Thomas, E. J. Swedback, and M. A. Spooner) across Mississippi River at Bemidji, Minn.*—General plans for construction of this dam under authority of act of Congress approved March 3, 1905, were approved March 2, 1906. Detailed plans were approved April 29, 1907.

*Water-power canal, etc., of the Davenport Water Power Company in Mississippi River at Rock Island Rapids, in Scott County, Iowa.*—Plans for construction of these works under authority of act of Congress approved April 5, 1904, as amended by act of February 5, 1907, were approved June 11, 1907.

*Lock and dam of the Atchafalaya and Lafourche Basin levee boards of Louisiana in Bayou Lafourche.*—Plans for construction of a lock and dam at this place under the provisions of the river and harbor act of June 13, 1902, were approved by the Secretary of War December 17, 1902, and November 20, 1903. (See Annual Report of the Chief of Engineers for 1904, p. 709.) The limit of time for removal of the temporary dam and the construction of locks was extended by the river and harbor act of March 2, 1907, to January 1, 1910.

#### MISCELLANEOUS.

[Public works not provided for in acts making appropriations for the construction, repair, and preservation of works on rivers and harbors.]

#### BRIDGES AT WASHINGTON, D. C.

Operations under this head were in the charge of Maj. Spencer Cosby, Corps of Engineers.

1. *Repair of the Aqueduct Bridge across Potomac River.*—(a) *Pier No. 5.*—The District of Columbia appropriation act approved July 1, 1902, contained the following item:

Repairs to Aqueduct Bridge: For construction of pier numbered five of the Aqueduct Bridge across the Potomac River at Georgetown, District of Columbia, to be expended under the direction of the Secretary of War, sixty-five thousand dollars.

Under the above authority a contract was made on April 22, 1903, for the complete reconstruction of pier No. 5. Work was started in the summer of 1903 and completed in December, 1904. Some difficulties were encountered during the pumping out and making water-tight of the cofferdam, but no very serious delays occurred.

The scheme of repair was radical, consisting of the entire removal of the old rubble masonry pier within a cofferdam built around it and its reconstruction of first-class ashlar masonry.

No interruption to bridge traffic was caused by the rebuilding operations.

More extended information will be found in the Annual Report for 1905.

A thorough examination of the pier below water was made by a diver in January, 1907, in connection with the examination of the old piers. Pier No. 5 was found to be in perfect condition. The balance remaining from the above appropriation being no longer needed for this pier, Congress was asked to authorize its expenditure, together with the balance remaining from the appropriation for the reconstruction of pier No. 4, for the periodical examination and repair of the remaining piers. This expenditure was authorized by item included in the District of Columbia appropriation act approved March 2, 1907.

July 1, 1906, balance unexpended.....	\$1, 612. 09
June 30, 1907, amount expended during fiscal year, for maintenance of improvement .....	51. 20

July 1, 1907, balance unexpended.....	<sup>a</sup> 1, 560. 89
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(b) *Repair of piers.*—Congress by joint resolution approved July 1, 1902, enacted as follows:

That the Secretary of War be, and he is hereby, authorized to spend an amount not exceeding three thousand dollars from the balance of appropriations made for the reconstruction of pier number four of the Aqueduct Bridge, District of Columbia, for the purpose of the examination of, and immediate temporary repairs to, the remaining piers of said bridge in cases of need arising from flood or ice.

The act of Congress approved March 2, 1907, making appropriations for the expenses of the government of the District of Columbia for the fiscal year ending June 30, 1908, contains the following item:

And the unexpended balance, amounting to about fourteen thousand dollars, of the appropriations for the reconstruction of piers numbered four and five of said bridge is hereby reappropriated and made available for the periodical examination of the remaining piers of the bridge and making of such repairs as may be found necessary.

Examinations of the piers by diver and such minor repairs as were found necessary have been made from time to time.

The last examination, made in December, 1906, and January, 1907, showed that most of the old piers were in need of repairs. The portions of these piers below water, with the exception of pier No. 1, the reconstruction of which was otherwise provided for, were repaired during April and May, 1907, and left in as good condition as practicable.

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<sup>a</sup> Reappropriated by act of March 2, 1907, consolidated, and carried to "Examination and repair of piers, etc."

## EXAMINATION AND REPAIR OF PIERS, ETC.

Balances transferred from piers 4 and 5 under act approved March 2, 1907-----	\$15,740.77
June 30, 1907, amount expended during fiscal year-----	687.40
July 1, 1907, balance unexpended-----	15,053.37
July 1, 1907, outstanding liabilities-----	44.50
July 1, 1907, balance available-----	15,008.87

## PIER NO. 4.

July 1, 1906, balance unexpended-----	\$12,437.11
June 30, 1907, amount expended during fiscal year-----	51.20
July 1, 1907, balance unexpended-----	<sup>a</sup> 12,385.91

## PIER NO. 4, ETC.

July 1, 1906, balance unexpended-----	\$2,213.37
June 30, 1907, amount expended during fiscal year-----	419.40
July 1, 1907, balance unexpended-----	<sup>a</sup> 1,793.97

(c) *Pier No. 1.*—The District of Columbia appropriation act approved March 2, 1907, contains the following item:

Aqueduct Bridge: For reconstruction of pier numbered one of the Aqueduct Bridge across the Potomac River at Georgetown, District of Columbia, to be expended under the direction of the Secretary of War, eighty thousand dollars.

An examination made in January, 1907, showed this pier to be in such condition that it was considered impracticable to repair it satisfactorily.

The above appropriation, or so much thereof as may be necessary, is to be applied to the removal of the present pier to bed rock and the building of a new and stronger pier in its place, the work to be done by contract.

Plans and specifications have been prepared and the work advertised. Proposals will be opened July 11, 1907.

Amount appropriated by District of Columbia appropriation act approved March 2, 1907-----	\$80,000.00
July 1, 1907, balance unexpended-----	80,000.00

(See Appendix F F F 1.)

2. *Highway bridge across Potomac River at Washington, D. C.*—

(a) *Construction.*—Section 12 of the act of Congress approved February 12, 1901, provides for the construction of a highway bridge to replace the existing Long Bridge, and appropriated the sum of \$568,000 for the purpose.

By authority of the Secretary of War a Board of Engineers was constituted to select a site and to formulate plans, specifications, and estimates for the bridge. The Board submitted a report, dated October 25, 1901, which was transmitted to Congress for its information. It is printed at page 2652 of the Annual Report of the Chief of Engineers for 1902.

<sup>a</sup> Reappropriated by act of March 2, 1907, consolidated, and carried to "Examination and repair of piers," etc.



The Board presented two plans, one for \$575,000 and one for \$996,000.

Congress, by act of July 1, 1902, authorized the increase of the limit of cost of the structure to \$996,000, but no actual additional appropriation was made.

Bids for the construction of the bridge across the main river were opened first on March 27, 1903, and all being in excess of the amount available were rejected.

As a result of the second bidding of July 25, 1903, on slightly revised plans and specifications, an agreement was entered into on August 29, 1903, for the erection of the bridge, the contract calling for its completion by February 12, 1905, in accordance with the requirements of the act of July 1, 1902.

By authority of the Secretary of War a Board of Engineer officers was constituted, consisting of the officer in charge of public buildings and grounds, the district engineer, and the Engineer Commissioner of the District of Columbia, for the consideration of plans for the approaches to the bridge, and a report upon the subject was submitted in January, 1904.

Upon the Board's recommendation and estimate the appropriation was further increased by the act of Congress of April 27, 1904, as follows:

For continuing construction, including approaches, of the highway bridge across the Potomac River at Washington, District of Columbia, and for any and all purposes connected therewith, four hundred and twenty-eight thousand dollars; and the total cost of said bridge and approaches shall not exceed one million one hundred and ninety-six thousand dollars.

By this act the appropriation was brought up to \$996,000, and the expenditure of \$200,000 additional, to cover the cost of approaches, etc., was authorized. This additional \$200,000 was finally appropriated by act of Congress of March 3, 1905, thus bringing the total appropriations up to \$1,196,000 for completing construction of the bridge and approaches and all purposes connected therewith.

On account of the time lost in preparation of plans and specifications and the obtaining of bids it was early seen that the time limit mentioned was unreasonable, and its extension for one year was recommended by the Department to Congress. By joint resolution approved February 18, 1905, Congress extended the time for completion to February 12, 1906.

The earth embankments for the approaches were chiefly constructed during the summer of 1905, when the rainfall was abnormally large. It was considered inadvisable to place permanent paving on the newly constructed embankments before they had had sufficient time to settle. A further extension of time was therefore recommended by the Department for the completion of the approaches, including the construction of a concrete-steel arch bridge across the Washington channel. By joint resolution of Congress approved February 19, 1906, the time for completion was extended to December 15, 1906.

Unexpected difficulties were encountered during the construction of the Washington channel bridge, and although every possible effort was made by the Government to hasten the work, it was found impossible to complete it by December 15, 1906. A further extension to June 30, 1907, was authorized by joint resolution of Congress approved January 18, 1907.



Construction work was commenced on the substructure of the main bridge in October, 1903, and suspended in December, because of prohibitive weather conditions. Not much beyond a little preliminary work, assembling of plant, materials, etc., was done during this period. Work on the substructure was resumed in March, 1904, and continued steadily until January, 1905, when severe weather conditions again necessitated its suspension. Fair progress was made during this season, though owing to slow deliveries of material not as much was accomplished as had been anticipated. The two abutments and seven of the twelve piers had been completed at the time of the suspension.

The erection of the superstructure was not commenced until September, 1904, and when operations were temporarily stopped in January, 1905, six spans had been assembled in place, swung clear of the false work, and partially riveted up.

Work was resumed on the substructure in March and on the superstructure in May, 1905. Work on the piers remaining unfinished was pushed rapidly to completion, the stonework of the last one being finished in the latter part of May.

The erection of steel was interrupted for a period of about seven weeks in June and July, 1905, by a general strike among the bridge men. The difficulty between the contractors and their employees was adjusted at the end of July and work on the superstructure continued uninterruptedly from that time until its completion in February, 1906. The bridge was opened to traffic on February 12, 1906, and has been in continuous use since.

Construction work was commenced on the reinforced concrete bridge across the Washington channel in the fall of 1905. Although progress has been unsatisfactory almost from the start, the bridge is now practically completed. It was opened to vehicular traffic June 27.

Descriptions of both bridges will be found in the Annual Report for 1906.

Embankments have been constructed on the approaches to both bridges. Those on the approaches to the main bridge were paved temporarily with macadam in the fall of 1905 and winter of 1905-6. In the fall of 1906, when it was considered that the fills had settled sufficiently to make the construction of permanent paving advisable, concrete roadway paving was laid over the macadam and sidewalks and concrete curbs were built. The permanent paving on the approaches to the Washington channel bridge was laid directly on the new fills during May and June, 1907.

Three flights of concrete steps have been constructed on the Washington approach embankment and the slopes have been sodded. The slopes on the Virginia approach have been planted with honeysuckle vines. Hand railings have been erected on the tops of the embankments for a short distance from each end of the main bridge. On the Virginia approach a pole line has been erected by the Western Union Telegraph Company and an overhead electric trolley system installed by the Washington, Alexandria and Mount Vernon Railway Company. This company has also installed temporarily a similar system on the Washington approach, which is now about to be replaced by a permanent underground conduit system.

A macadam roadway for the use of light vehicles and automobiles is being built alongside the concrete roadway on the Virginia approach and is nearly completed.

On the Washington approach drainage and electric lighting systems have been installed and conduits laid for telegraph, telephone, light, and power cables.

All of the Government work in connection with the construction of the highway bridge and approaches is now practically completed, except such minor details as placing the lamp posts on the Washington channel bridge, finishing the macadam road on the Virginia approach, cleaning up, etc. The principal work remaining to be done is the installation by the Washington, Alexandria and Mount Vernon Railway Company of its underground conduit system and the placing of paving between and alongside its tracks on the Washington approach.

July 1, 1906, balance unexpended.....	\$146,636.76
June 30, 1907, amount expended during fiscal year.....	114,283.72
July 1, 1907, balance unexpended.....	32,353.04
July 1, 1907, outstanding liabilities.....	523.91
July 1, 1907, balance available.....	31,829.13
July 1, 1907, amount covered by uncompleted contracts.....	28,016.13

(b) *Maintenance and operation.*—The District of Columbia appropriation act, approved June 27, 1906, contains the following item:

Highway bridge across Potomac River: For salaries of employees, lighting, power, and miscellaneous supplies, and expenses of every kind necessarily incident to the operation and maintenance of the bridge and approaches, eleven thousand six hundred dollars, and estimates in detail shall be submitted hereunder for the fiscal year nineteen hundred and eight, and annually thereafter.

This appropriation has been applied to the payment of salaries of draw operators, watchmen, and laborers, to superintendence and inspection when necessary, to providing current for operating the draw and for lighting the bridge and Washington approach, and to repairs, telephone service, purchase of tools, supplies, etc.

The sum of \$16,000 was appropriated for this service during the year ending June 30, 1908, by the District of Columbia appropriation act of March 2, 1907.

An estimate of \$16,000 for the payment of expenses incident to operation and maintenance of the bridge and approaches during the fiscal year ending June 30, 1909, is herewith submitted in detail, as required by the above-quoted act.

ESTIMATE OF COST OF MAINTENANCE AND OPERATION FOR FISCAL YEAR ENDING JUNE 30, 1909.

Salaries:	
2 draw operators, at \$1,080 each.....	\$2,160
1 draw operator, at \$720.....	720
4 watchmen, at \$600 each.....	2,400
Labor, for cleaning roadway, etc.....	1,500
Total for salaries (regular).....	6,780
Current for operating 6,000 openings, at 9 cents.....	540
Lighting 49 arc lights, at \$85.....	4,165
Lighting 20 gas burners, at \$20.85.....	417
Telephone service.....	63
Fuel for heating operating house.....	60
Miscellaneous supplies, grease, oil, waste, etc.....	375
Painting and repairs.....	2,500
Contingencies (additional labor, etc.).....	500
Superintendence and office expense.....	600
Total.....	16,000

## APPROPRIATIONS.

March 3, 1905.....	\$7, 000
June 27, 1906.....	11, 600
March 2, 1907.....	16, 000

34, 600

## MAINTENANCE OF HIGHWAY BRIDGE ACROSS POTOMAC RIVER, DISTRICT OF COLUMBIA, 1906.

July 1, 1906, balance unexpended.....	\$2, 280. 51
June 30, 1907, amount expended during fiscal year.....	2, 179. 70
August 27, 1906, balance unexpended, reverted to Treasury.....	100. 81

## MAINTENANCE OF HIGHWAY BRIDGE ACROSS POTOMAC RIVER, DISTRICT OF COLUMBIA, 1907.

Amount appropriated by act approved June 27, 1906.....	\$11, 600. 00
June 30, 1907, amount expended during fiscal year.....	9, 926. 90
July 1, 1907, balance unexpended.....	1, 673. 10
July 1, 1907, outstanding liabilities.....	1, 181. 09
July 1, 1907, balance available.....	492. 01
July 1, 1907, amount covered by uncompleted contracts.....	385. 23

{ Amount that can be profitably expended in fiscal year ending June 30, 1909, for maintenance and operation, in addition to the balance unexpended July 1, 1907..... 16, 000. 00  
(See Appendix F F F 2.)

## MAINTENANCE AND REPAIR OF THE WASHINGTON AQUEDUCT, DISTRICT OF COLUMBIA, AND WASHINGTON AQUEDUCT, DISTRICT OF COLUMBIA, FILTRATION PLANT.

Operations under this head were in the charge of Maj. Spencer Cosby, Corps of Engineers, having under his immediate orders First Lieut. E. J. Dent, Corps of Engineers.

1. *Washington Aqueduct, District of Columbia.*—Appropriations for the Washington Aqueduct are applied to the improvement, maintenance, and repair of those parts of the water-supply system which are under the supervision of the Chief of Engineers. These are the masonry dam across the Potomac at Great Falls, the works there for regulating the supply to the conduit, the Conduit road from Great Falls to Washington, a distance of about 14 miles, the conduit from Great Falls to the distributing reservoir, a distance of about 12 miles, the three reservoirs for supplying the city, the tunnel connecting the distributing and Washington City reservoirs, the two bridges for carrying the mains across Rock Creek, and other auxiliary works. A description of these works may be found in the Annual Report of the Chief of Engineers, 1903, pages 2485-2487.

The original project for construction of the Washington Aqueduct was dated February 12, 1853, and published as Senate Executive Document No. 48, Thirty-second Congress, second session. The project provided for supplying the city of Washington with water taken from the Potomac River at Great Falls, Maryland, about 14 miles above the city and 16½ miles from the present filtration plant, and with water from Little Falls Branch. Work was begun in 1853, and in 1859 water from Little Falls Branch was supplied to the city

through the conduit. The first Potomac water was supplied to the city in December, 1863.

The capacity of the system in 1863 was 42,000,000 gallons per day. The water from Little Falls Branch became polluted and works for excluding it were completed in 1895. The dam at Great Falls was raised during 1896 and the capacity of the system increased to its present extreme limit of 95,000,000 gallons per day, or, making allowances for sudden increases in consumption, to a safe limit of 65,000,000 gallons. For a discussion of the capacity of the system, see Annual Reports, Chief of Engineers, for 1897, pages 3991-4014, and for 1906, pages 2093-2095.

During the year the feeder at Great Falls was cleaned twice; the tunnel between the Georgetown and Washington City reservoirs was partially pumped out, and the portion in the vicinity of Rock Creek shaft was inspected; about 3,400 cubic yards of broken stone were placed on the Conduit road; a new floor was laid on the Pennsylvania avenue bridge across Rock Creek; the wooden bridge at Dalecarlia Reservoir was replaced by a concrete culvert and earth fill; and all buildings, grounds, and other structures were maintained in good order and condition.

The practice of closing the gates at Great Falls during periods of high turbidity was continued with good results.

Attention is invited to that portion of the report of the officer in charge which deals with the subject of consumption and waste of water. The present system can not safely supply a greater quantity of water than is now taken from it, and provision must be made either for materially cutting down the waste or for increasing the supply to provide for the increase in population and the enlarged per capita consumption due to modern conditions of living. The danger of an interruption of the supply is discussed in the Annual Report of the Chief of Engineers for 1906, pages 815 and 816.

The estimates for the fiscal year ending June 30, 1909, are as follows:

For operation, including salaries of all necessary employees, maintenance and repair of the Washington Aqueduct and its accessories, including the Conduit road, the Washington City reservoir, and the Washington Aqueduct tunnel, and also including the purchase and maintenance of horses, vehicles, and harness and the care and maintenance of the stable	\$33,000
For preliminary investigations and surveys for increasing the water supply	10,000
For construction of a dwelling for an assistant watchman at Great Falls, Md.	3,000
For construction of a combined storehouse and stable at Great Falls, Md.	3,000
For parking the grounds at the Washington City reservoir	6,000
For emergency fund to be used only in case of a serious break requiring immediate repair in one of the important aqueduct or filtration plant structures, such as a dam, conduit, tunnel, bridge, building, or important piece of machinery, all expenditures from this appropriation to be reported in detail to Congress	5,000

It will probably be impossible to complete the dredging and riprapping in Dalecarlia reservoir during the fiscal year 1908. A reappropriation of the balances at the end of the fiscal year 1908 from the following appropriation is therefore recommended:

For removal by dredging of about 134,000 cubic yards of sediment from Dalecarlia reservoir, \$16,000.

For riprapping the sides of Dalecarlia reservoir for a width of about 20 feet, \$18,000.

WASHINGTON AQUEDUCT, D. C., 1906.

July 1, 1906, balance unexpended.....	\$2, 245. 57
June 30, 1907, amount expended during fiscal year.....	2, 213. 11
December 10, 1906, balance unexpended reverted to Treasury.....	32. 46

WASHINGTON AQUEDUCT, D. C., 1907.

Amount appropriated by act approved June 27, 1906.....	\$33, 000. 00
June 30, 1907, amount expended during fiscal year.....	29, 274. 88
July 1, 1907, balance unexpended.....	3, 725. 12
July 1, 1907, outstanding liabilities.....	3, 568. 53
July 1, 1907, balance to revert to Treasury.....	156. 59

(See Appendix G G G 1.)

2. *Washington Aqueduct, District of Columbia, Filtration Plant:*  
(A) *Construction.*—By act of Congress approved June 6, 1900, the sum of \$200,000 was appropriated—

For establishing those portions of a filtration plant which are essential to the operation of either system of filtration adopted \* \* \*.

By act of Congress approved March 1, 1901, the sum of \$500,000 was appropriated—

Toward establishing a slow sand filtration plant \* \* \*.

By these and subsequent acts of Congress there has been appropriated for this work a total sum of \$3,468,405.

At the beginning of the fiscal year the work had been practically completed. A storehouse and an experimental filtration plant were built and some grading was done during the year by day labor. No new contracts were entered into and all contracts in force at the beginning of the fiscal year were closed, except the contract with Henry R. Worthington for the main pumping engines. Very little work was done under any of the contracts.

Under the contract with Henry R. Worthington new condensers were installed in the discharges of the main pumps and the guaranteed efficiency was obtained. This contract has been practically completed.

The necessity for completing the plant by the construction of works for preliminary treatment of the water is briefly discussed by the officers in charge under the head of "Maintenance and Operation."

July 1, 1906, balance unexpended.....	\$112, 929. 36
Amount reverted from maintenance and operation April 30, 1907.....	21, 539. 78
June 30, 1907, amount expended during fiscal year.....	134, 469. 14
July 1, 1907, balance unexpended.....	66, 555. 35
July 1, 1907, balance unexpended.....	67, 913. 79
July 1, 1907, outstanding liabilities.....	1, 149. 52
July 1, 1907, balance available.....	66, 764. 27
July 1, 1907, amount covered by uncompleted contracts.....	11, 674. 61

(See Appendix G G G 2.)

3. *Washington Aqueduct, District of Columbia, Filtration Plant: (B) Maintenance and operation.*—By act of Congress approved March 3, 1905, the sum of \$70,000 was set aside out of the various sums appropriated for the construction of the Washington Aqueduct, District of Columbia, Filtration Plant, to be applied to maintenance and operation for the fiscal year ending June 30, 1906. Of this sum \$49,108.57 was expended and the balance reverted to the appropriation for construction. By act of Congress approved June 27, 1906, the sum of \$80,000 was appropriated for maintenance and operation for the fiscal year 1907.

The Washington Filtration Plant consists of a pumping station for raising the water from the Washington City reservoir to the filters; of 29 filter beds of the slow-sand type, having an effective filter area of 1 acre each; of a filtered water reservoir, having a capacity of about 15,000,000 gallons; of the necessary piping and valves for carrying the water, controlling the rates of filtration, etc.; of a sand-washing and storage system, and of a laboratory for testing the water. The filtration plant has been in continuous and successful operation throughout the year and the entire water supply of the city has been filtered. The bacteria have been reduced from an average of 633 per cubic centimeter in the Washington City reservoir to an average of 31 in the filtered water reservoir. The average turbidity has been similarly reduced from 29 to 2 parts per million. The actual number of bacteria in the city water varied from 4 to 200 per per cubic centimeter during the year, while the number in the river water ran from 70 to 63,000, showing an actual reduction varying between 85 and 99.9 per cent.

The work during the year consisted in cleaning and operating the filters; in analyzing samples of water from the several reservoirs, from each filter, and from taps at various parts of the city; in operating and keeping in repair the pumping station, and in doing the necessary clerical work connected with the office. All work was done by day labor.

The total quantity of water pumped to the filters during the year was 24,417.73 million gallons, or an average of 66.89 million gallons per day. During the year 33,900 cubic yards of sand were washed and 34,781 cubic yards were replaced in the filters. While the quality of the city filtered water has been excellent bacteriologically, it has not been satisfactory from the point of view of turbidity. This has been sufficient to be noticeable during a large part of the year. This confirms the experience of the previous fiscal year and also the judgment of the three experts as expressed in their report, dated February 18, 1901, to the chairman, Senate Committee on the District of Columbia.

An experimental plant has been in operation since February 8, 1907, with the object of determining the best method of reducing the turbidity. The present indications are that the most feasible means of clarification will be found to be some system of preliminary coagulation, such as was recommended by Messrs. Hering, Fuller, and Hazen, in the above-mentioned report.

Experiments with the sand-handling and sand-washing apparatus resulted in some small changes which greatly increased the efficiency of the system.

The cost per million gallons filtered was \$3.07.

A more complete description of the Washington Filtration Plant may be seen in the Annual Report of the Chief of Engineers for 1906, pages 2101 and 2102.

The following estimate of the cost of maintenance and operation of the Washington Aqueduct, District of Columbia, Filtration Plant, for the year ending June 30, 1909, is submitted:

1 superintendent .....	\$3, 000
1 chief chemist and assistant superintendent .....	2, 100
1 first assistant chemist .....	1, 500
1 second assistant chemist .....	1, 000
1 stenographer and clerk .....	1, 200
2 janitors, at \$600 each .....	1, 200
1 chief steam engineer .....	1, 800
1 first assistant steam engineer .....	1, 440
1 second assistant steam engineer .....	1, 080
1 machinist .....	1, 140
1 blacksmith, at \$3.50 per day, 300 days .....	1, 050
3 oilers, at \$900 each .....	2, 700
3 firemen, at \$900 each .....	2, 700
3 laborers, at \$540 each .....	1, 620
1 filter foreman .....	1, 500
1 assistant filter foreman .....	1, 080
3 foremen, at \$900 each .....	2, 700
3 watchmen and gauge tenders, at \$900 each .....	2, 700
5 skilled laborers, at \$720 each .....	3, 600
44 laborers, at \$1.50 per day, for 300 days .....	19, 800
7 teams with drivers, at \$2 per day, for 200 days .....	2, 800
Laboratory and office supplies .....	800
4,500 tons of coal, at \$3.80 .....	17, 100
Pumping station supplies, oil, waste, packing, repairs, etc .....	7, 000
Filter supplies, tools, hose, and repairs .....	8, 000
 Total .....	 90, 610

WASHINGTON AQUEDUCT, DISTRICT OF COLUMBIA, FILTRATION PLANT, MAINTENANCE AND OPERATION.

July 1, 1906, balance unexpended .....	\$28, 421. 98
June 30, 1907, amount expended during fiscal year .....	6, 882. 20

July 1, 1907, balance unexpended, reverted to Washington Aqueduct,  
District of Columbia, filtration plant, construction, April 30, 1907.. 21, 539. 78  
(See Appendix G G G 2.)

MAINTENANCE, WASHINGTON AQUEDUCT, DISTRICT OF COLUMBIA, FILTRATION PLANT, 1907.

Amount appropriated by act approved June 27, 1906 .....	\$80, 000. 00
June 30, 1907, amount expended during fiscal year .....	70, 833. 28

July 1, 1907, balance unexpended .....	9, 166. 72
July 1, 1907, outstanding liabilities .....	5, 974. 23

July 1, 1907, balance available .....	3, 192. 49
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July 1, 1907, amount covered by uncompleted contracts .....	2, 499. 75
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(See Appendix G G G 2.)



IMPROVEMENT AND CARE OF PUBLIC BUILDINGS AND GROUNDS  
AND CARE AND MAINTENANCE OF THE WASHINGTON MONUMENT,  
IN THE DISTRICT OF COLUMBIA.

Officer in charge, Col. Chas. S. Bromwell, U. S. Army.

Extensive repairs and betterments were made about the Executive Mansion. Much miscellaneous painting was done in the apartments on the ground floor and on the second (bedroom) floor. Work was commenced in June, 1907, for repainting the entire exterior. Four rooms on the drawing-room floor were repainted, the furniture in four of them refinished, reupholstered, and re-covered, the walls of two of them re-covered with new material, and new window hangings provided for three rooms. Extensive changes were made in the cloak corridor in the east terrace to better adapt it for the use of guests. Necessary repairs were made about the east terrace, including a new roof covering and rewiring for electric lights, and the west terrace was treated in the same way. A new tin roof was placed on the mansion. Additional fire protection installed, a new pavement of Indiana limestone laid on the north portico, a new asphalt pavement laid on the north area, and an old asphalt walk at the south front replaced with a new cement walk.

At Ford's old theater building, work for replacing an old steam boiler with a new one completed.

The house and lot No. 204 L street NW., sold at public auction by authority of act of Congress approved June 30, 1906.

Two steel arms put in for equalizing the unequal expansion of the cables of the elevator at the Washington Monument, and the usual care extended to the shaft and the machinery connected therewith.

Inspections made each month of the buildings occupied as offices by the War Department, except the State, War, and Navy Department building, in connection with their care, preservation, and safety.

The care required to maintain them in good condition was extended to the improved parks and park places. Six park spaces added to the system by the transfer of six parcels of ground from the Commissioners of the District of Columbia to the Chief of Engineers. Two unimproved reservations improved, and the portions of Potomac Park along the north and west sides of the tidal reservoir and along the river side between the inlet to the reservoir and the mouth of the Seventeenth street sewer canal improved. Cement coping constructed around five reservations, a total of 4,069 feet of coping and 24 corner posts; 12,792 square yards of sod laid on bare lawns; gravel roadways resurfaced with crushed stone. Work commenced changing the location of the southeast end of the river drive in Monument Park annex. Five park lodges, 551 park settees, 2,206 iron posts, 5,451 feet of iron bars, and 11,314 feet of iron chain in park fences painted; 21,046 feet of water pipes and 3,647 feet of drainpipe laid, and 3,131 feet of brick gutters and 66 catch basins constructed, 17 additional park electric lights erected, 1,233 square yards of new asphalt roadway and 88.7 square yards of new asphalt footwalk and 1,950 square yards of old asphalt footwalk repaired, and 4,150 square yards of new cement footwalk constructed.

At the propagating gardens the various structures repaired and maintained in good condition. Over 1,000,000 plants propagated and



269 trees, 2,339 shrubs, 31,000 bulbs, and 979,649 plants planted in the public parks.

The statue of General McClellan completed, erected, and unveiled; the full-size models of the bronze lions for the Grant memorial completed, a model for the Pulaski statue approved, a contract entered into for the Von Steuben statue, and the working model of the statue completed by the sculptor. A model selected for the statue of Kosciuszko, and a site selected for the statue of Longfellow.

Improvement and betterments made in the departmental telegraph line and the overhead line on Fourteenth street, between B street north and B street south, placed underground.

Attention is invited to the detailed report of the officer in charge, and to his estimates and recommendations for the fiscal year ending June 30, 1909.

The estimates are as follows:

For the improvement and care of public buildings and grounds in charge of the Chief of Engineers.....	\$360, 470
For compensation of persons employed by office of Public Buildings and Grounds.....	84, 670
Telegraph lines connecting Capitol with Departments: Care and repair of existing lines.....	1, 500
For contingent and incidental expenses of public buildings and grounds..	1, 000
For care of Washington Monument and maintenance of elevator:	
Salaries of employees .....	\$8, 820
Fuel, lights, contingencies, etc.....	3, 000
	11, 820
For monument and wharf at Wakefield, Va., the birthplace of Washington: Repairs to wharf.....	7, 000
For rebuilding sea wall on Potomac River front between arsenal wall and N street south.....	7, 500
Total.....	473, 960

(See Appendix H H H.)

#### NORTHERN AND NORTHWESTERN LAKES—CORRECTING AND ISSUING CHARTS—SURVEYS—WATER LEVELS. PRESERVATION OF NIAGARA FALLS.

As early as 1816 local surveys of the Great Lakes for special purposes were made by engineer officers, but the "Lake Survey" as a systematic work was commenced in 1841. It was diligently prosecuted thereafter until 1882, when for a time extended field operations were suspended. The correction, printing, sale, and issue of charts continued without cessation, however, the additions and corrections being largely based upon local surveys and reports by engineer officers in charge of the river and harbor improvements on the lakes.

Systematic field work was resumed in 1889, and has since been prosecuted with increased vigor. In 1898 operations were extended to include cognate work of observing and investigating the levels of the Great Lakes and their connecting waters, with a view to their regulation in the interest of commerce. The survey proper has from the beginning been carried on under the War Department, being at first conducted by the Chief of Topographical Engineers, and by the Chief of Engineers after the consolidation of the Topographical Engineers with the Corps of Engineers.

During the past year under an allotment of \$5,000 from the appropriation for the "Preservation of Niagara Falls" made by the act

approved June 29, 1906, field observations and measurements have been made for the study and determination of the effect produced by the abstraction of water from the Niagara River by certain power companies.

The first regular appropriation for the Lake Survey was made in 1841, and annual appropriations followed, with the single exception of 1847. The appropriations to date for all purposes of the Survey during the sixty-six years of its existence have aggregated \$4,061,879, of which \$2,411.81 has reverted to the Treasury.

The following extract from Professional Papers of the Corps of Engineers, United States Army, No. 24, describes the conditions governing the navigation of the Great Lakes in 1841:

The Lake Survey was begun in 1841 under an appropriation of \$15,000 made in May of that year. At this time the country bordering on the lower lakes was already pretty well settled, and works for the improvement or formation of harbors had been commenced at most of the important points on Lakes Erie and Ontario. The upper lake region was but thinly settled, and there were no good harbors on Lake Huron and but one (the harbor of Chicago) on Lake Michigan. Settlers were, however, pouring in rapidly, and there was even then a large and constantly increasing commerce between the lake ports, especially from Buffalo to Detroit and Chicago. Communication with Lake Superior could only be had by portage around the Sault Ste. Marie, but the great mineral wealth of the country was attracting attention, and a survey for a ship canal had been made in 1840 by officers of the Topographical Engineers. The lake commerce was carried on under many difficulties, which caused much loss of life and property each year.

There were no charts of the lakes except the Admiralty charts, compiled from the surveys of Capt. H. W. Bayfield, of the royal navy (English), and these were not in general use by the masters of American vessels. These charts were the results of rapid reconnaissances, and although they showed the coast lines with an accuracy which is remarkable considering the rough methods of surveying employed, they were of little value as hydrographical charts of the American coast, because they showed the depths of water in comparatively few places and but a small number of the many reefs and shoals which are found along the lake shores.

There were few light-houses and beacons to indicate the positions of dangers to navigation, and, in the absence of charts, pilots were obliged to rely upon their own knowledge, which was frequently only acquired by the vessels grounding on a shoal or striking a hidden rock.

The navigation of the lakes is attended with peculiar dangers, because, while violent gales are frequent and the storms rival those of the ocean itself, a vessel is never more than a few hours' run from the shore and can not, as is generally the case at sea, drift before the wind until the storm is over, but in a long-continued gale must be thrown upon the shore, unless a port or harbor of refuge can be entered. In 1841 a vessel leaving Chicago found no harbor or shelter in storms until the Manitou or Beaver islands were reached, and after passing the Straits of Mackinac it was again exposed without refuge on Lake Huron, except in the vicinity of Presque Isle, until the head of St. Clair River was reached. In sailing from Chicago to Buffalo the greatest difficulties were encountered in the vicinity of the Straits of Mackinac and in the west end of Lake Erie on account of the many islands, shoals, and reefs found in those localities, and at the mouth of the St. Clair River, at which no improvements had been made in 1841, and where the channels were not only circuitous and narrow, but so shoal that vessels in low-water seasons frequently were compelled to have their cargoes taken over the bars in lighters.

It was therefore with the double object of furnishing reliable charts to lake vessels and of determining from the surveys the works of improvement which were necessary to the prosperity of the lake commerce that Congress in 1841 directed a survey of the lakes, and that annual appropriations, with the single exception of the year 1847, have since been made for carrying on the survey.

During the first ten years of the Survey, while a general geodetic survey of the entire chain of lakes was contemplated for the future, the actual operations were mainly confined to surveys of special localities where improvements were

called for or where the navigation was difficult: and where the surveys were more extended they were little more than reconnaissances. This course was made necessary because the appropriations were inadequate to the purchase of the finer instruments and the support of the larger force necessary for more extensive and more exact surveys, and also because of the pressing need of improvements at particular localities, for which preliminary surveys were essential.

Up to the present time the object of the operations of the Lake Survey has seemed so definite that the work has been conducted under projects covering specifically the expenditure of the appropriations as made by Congress, and no general project covering the whole future operations of the Survey has seemed essential, since almost necessarily the more vital and important parts of the work were disposed of as early as conditions would permit.

The advisability of such a policy as would form the proper basis of a general project has never been overlooked, but the fact that hitherto the Survey has kept well in advance of the needs of navigation shows that the work has been well selected and organized.

A general project covering to completion the operations of the Survey seems now desirable, and in the following paragraphs are presented the basis and explanation of the project now submitted.

The Great Lakes and their connecting waterways are properly the right of way of a vast transportation system, and the burden of exploring and improving this right of way to give it the greatest efficiency and safety has been assumed by the nation.

The water area of the Great Lakes and the connecting and out-flow rivers is about 95,000 square miles, of which about two-thirds is on the American side of the international boundary. The shore line is about 8,345 miles and of this the American line is 4,700 miles. As a basis of comparison the total shore line of the Atlantic, Pacific, and Mexican seaboard of the United States, excluding Alaska and all islands, is stated, in Senate Executive Document No. 74, Fifty-third Congress, second session, to be 5,705 miles long. These figures are, however, somewhat elastic, as the measurement varies with the closeness with which the sinuous shore line is followed.

During the past the work of the Survey has not been limited by the national boundary, because the predominance of the navigation interests of the United States, amounting to 95 per cent of the commerce of the lakes, has warranted surveys extending to those parts of the main traveled vessel tracks passing through Canadian waters; and, where essential to the integrity of navigation charts, as along rivers and where the vessel courses lay close to the Canadian shore, this shore line has also been surveyed. It is well known that the same principle has been applied to channel excavation in the connecting rivers of the lakes.

The principle that alien waters are properly subject to exploration and improvement when traversed by the nation's commerce is unquestionable, and the total area over which the operations of the Lake Survey should properly extend is 70,000 square miles and its shore line not less than 6,000 miles.

Of this water area a large part is regarded as safe for navigation of present maximum draft, but much of it has never been explored, and, without close soundings or sweeping, the evidence is either largely negative, as based upon the absence of disasters indicating

shoals, or else is presumptive and based upon the probable continuity of deep water between widely separate soundings. Increased draft in lake vessels is likely to reveal unknown shoals safely crossed with present drafts. Fishermen have reported banks requiring examination in an unsounded area of 500 square miles in Lake Superior, a 30-foot bank is known to exist in the middle of Lake Huron, and a 24-foot spot 8 miles off Chicago has recently been reported. Such reports of unknown shoals are received every season, and examinations of the regions follow.

In certain portions of the Great Lakes the lines of traffic converge and finally follow a single course or track. The course in the west end of Lake Erie from Detroit River light past Colchester light and through Pelee Passage is an illustration of a short well-marked track carrying in fair weather probably 95 per cent of the Detroit River tonnage. But in unfavorable weather vessels frequently turn into Pigeon Bay for shelter, and in thick weather compass errors and drift spread the vessels so that the clear roadway needed should have the greatest possible width. While the limitation to fixed tracks applies especially to the larger class of ore and coal carrying freighters, the passenger and fruit boats, on the other hand, and those in the Toledo and Sandusky trade, make a mesh of roadways covering nearly the full lake area in this vicinity. In a month's examination in 1905 the Lake Survey steamer *General Williams* discovered three new rock shoals in this region, and the formation of the bottom and the neighboring island outcrop indicate the probable presence of many more shoals.

While vessels endeavor to follow definite tracks, these vary somewhat with the season of the year and with wind and weather conditions. In fair weather the natural economical tendency is to take the shortest path, but during gales the weather shore is favored, and during fogs the shore is given a wide berth. On the ocean a vessel may run before a storm which it is hazardous to face, but on the lakes—unless the storm trends lengthwise of the lake—sea room is lacking for this safe course. The latter condition makes navigation during gales more difficult upon the lakes than on the high seas, and this difficulty should be reduced to the greatest practicable extent by a correct knowledge and charting of all areas providing sea room or anchorage.

During the season of 1905 there were 230<sup>a</sup> casualties to vessels engaged on the Great Lakes, 173 lives and \$3,952,750 being lost. The gale of November 28 alone caused the loss of 30 lives, 35 vessels, and \$1,881,000. Probably none of these losses was due to incomplete charts, but during such storms the conception of limited roadways for vessel traffic completely disappears. The entire area of each lake must then be known and available, and the lee of every island, every bay, and every passage becomes a possible refuge whose exact condition must be correctly charted. The obscure out-of-the-way road of times of quiet becomes the haven of times of stress and peril. It therefore follows that no part of the 70,000 square miles of the water area of the lakes is properly exempt from surveys. In much of it examination need not be minute, but on the other hand there are areas

<sup>a</sup> This includes losses by fire and damage by ice.

whose depth is so critical that sounding alone is not sufficient, and sweeps must be used to detect bowlders and rock pinnacles. The latter class of examinations, when in exposed localities, are costly because of delays due to weather, a working season of six months duration ordinarily affording only one hundred working days—still enough for sounding and sweeping.

Since the work of the Lake Survey was started a vast transportation system has developed and is still rapidly expanding. During the calendar year 1906 the domestic lake freight traffic amounted to 75,610,690 net tons, with a valuation of \$780,000,000, the American vessels of the lake fleet being valued at \$125,000,000. Taking the average trip rate per ton as 66 $\frac{2}{3}$  cents, a conservative estimate, the freight charges amount to over \$50,000,000. Rail rates are fully three times as much as the water rates, so that the saving to the nation by reason of lake transport was over \$100,000,000 for the year.

This saving of a single year is more than the United States has spent up to the present time on the Great Lakes for all surveys, harbor and channel improvements, locks, and canals. Capitalizing this yearly saving at 4 per cent would show the value of this national right of way to be \$2,500,000,000. The domestic traffic on the Great Lakes is increasing at the rate of about 10 per cent annually, and by 1910 promises to reach the billion mark with an annual national saving of over \$133,000,000.

Meanwhile deeper waterways are economical, and are being made. Each additional foot of draft for the large carriers means an increase of 10 per cent in freight-carrying capacity with practically no added operating cost. Eventually this should lead to lower charges and increased saving to the nation.

In these deductions no cognizance is taken of the enormous passenger traffic of lakes, which reduces travel considerably below rail charges, and is an economic fact.

While the various engineer districts of the Great Lakes are charged with the duty of improving the terminal harbors and the connecting rivers, the Lake Survey alone has charge of the examination and exploration of the vastly larger and more dangerous areas of the right of way proper. It charts this right of way, searches for undiscovered or obscure dangers, studies the hydraulics of the lakes, so as to furnish data for the solution of the problem of maintaining more uniform surface levels, bettering drafts, and protecting the lakes from the dangers threatened by water diversions. It collects from original sources and publishes in bulletins information valuable to the carriers and gives warning of the exact nature and position of newly discovered shoals, wrecks, derelicts, and other dangers.

The importance of the function of the Lake Survey increases with the total volume of traffic and with the size of the individual carriers. A single 600-foot freighter with its cargo is worth more than the total cost of maintaining the Lake Survey for more than three years; and prompt notification of the position of obscure or recently created dangers may in one year save many such vessels.

In the past the Lake Survey has done a most laborious and creditable work. Its splendid system of triangulation is not excelled, and its early hydrography, though originally planned for 12-foot navigation, with depths measured below mean lake level was, despite the

crudeness of earlier methods and the less adequate equipment of those days, a work of great practical value.

In the earlier surveys the necessity of careful examination of areas deeper than 18 feet was not anticipated, and many of the original charts were prepared for a navigation of a draft not exceeding 12 feet, with soundings referred to mean or average stages of water. The failure to forecast the vast development of lake commerce is illustrated by the history of the construction of the ship locks. As late as 1881 the Weitzel lock at Sault Ste. Marie was completed with 15 feet of available depth. In 1896 the Poe lock was opened with a depth of less than 20 feet, and the latest project now adopted by Congress calls for a new lock with 24½ feet.

Because, in the hydrographic surveys prior to 1870, and even those from 1870 to 1878, the same failure to anticipate the extraordinary development of lake commerce existed, it has been found necessary to resurvey much of the area covered by prior work. Since 1900 many such areas have been reexamined, and due weight is now given not only to possible future growth, but also to the increased depth needed during storms. The fair-weather level of a lake is subject to serious local temporary lowerings during severe gales, the water being crowded to the end toward which the wind blows. The west end of Lake Erie has been lowered over 6 feet in a westerly gale. The rise and fall and pitching of a vessel in such a storm calls for more water than her normal still draft, and the sum of these two—low water and surging—makes a 24-foot shoal a dangerous menace to 20-foot navigation. Minute care is now taken in the examination of shoals and critical areas to the depth which the requirements of commerce demand, of 30 feet in the open lakes and 25 feet in the connecting rivers, referred to low-water stages instead of the mean lake level.

To illustrate the need of this Survey, it may be stated that in a single season's work upon the upper St. Lawrence River in 1902, one hydrographic party alone discovered 31 new shoals, mostly rock, and this experience has been repeated in other localities, modern methods and equipment and more minute examination being largely the cause of these discoveries.

To explain these discoveries it must be borne in mind that hydrographic surveys search for invisible submarine obstacles. Assuming that soundings are taken on north-and-south lines and on east-and-west lines 660 feet apart, thus dividing the area to be examined in checkerboard fashion, the travel of a survey boat in sounding a square mile would be 16 miles, a half day's work at practicable sounding speed. And yet a shoal as large as a city block might still exist undiscovered in one of the squares. With a more minute survey on lines 220 feet apart a day and a half of boat work would be needed. In rock formation a mass as large as a house might still readily remain undiscovered. As sweeping alone will with certainty discover isolated obstacles, and as the earlier surveys were by soundings, it is easy to understand why the resurvey discovers new shoals and, on old ones, occasionally finds less water than was found before.

The recent successful use of the long horizontal wire sweep, introduced by Principal Assistant Engineer F. C. Shenehon, of the Lake Survey, has rendered sweeping possible at a cost no greater than sounding upon lines 660 feet apart, and areas so examined may be certified clear of obstacles.

While surveys by sounding and examination by sweeping have disclosed many shoals not previously known, many have been discovered by vessels striking them, with resulting loss or injury. The following is a partial list of shoals bearing the names of the vessels striking them:

St. Lawrence River—Bay State shoal, Superior shoal, Haskell shoal, Empire shoal, Frontenac shoal, Niagara shoal, Granite State shoal, Rugee shoal, Buckeye shoal, Brantford shoal.

Lake Erie—Seneca shoal, Waverly shoal, American Eagle shoal, Grecian shoal.

Lake Huron—Harlem shoal, Corsica shoal.

Straits of Mackinac and Lake Michigan—Majors shoal, Corona shoal, Vienna shoal.

St. Marys River and Lake Superior—Empire ledge, Atlantic rock, Cambria bank, Merida shoal, Hutchinson shoal.

Fishermen in search of fishing banks have discovered some shoals. In all cases minute investigations is promptly made of information received from the above-mentioned sources, and the results are immediately charted, and also issued in the form of bulletins.

While reliable information from all possible sources is used to the fullest possible extent in perfecting the charts, including that from district officers and from recent excellent Canadian surveys, great care is taken to avoid useless duplication of work already adequately performed either by the Lake Survey itself or by some other agency of equal trustworthiness. On the other hand natural causes have created new shoals and shifted old ones, particularly in the river deltas at the mouth of the St. Clair, Detroit, and Niagara rivers, and such areas require periodical reexamination. Southeast shoal, just outside of Point Pelee in Lake Erie, is skirted by 95 per cent of the lake tonnage and furnishes an excellent illustration of the necessity for periodical resurvey of such localities. Ice and storms occasionally shift existing shoals and build new ones.

The charts published by the Lake Survey are intended to furnish such information only as is needed by navigators. This includes shore-line topography and harbor charts, which should be kept revised so as to show docks, new buildings, and, in short, all changes in shore lines which may serve to help a master in identifying accurately his ship's position.

A brief reference has already been made to the hydraulic work of the Lake Survey. This, while yet incomplete, owing to limitations brought about by natural conditions, is of great magnitude and importance. To the extent of recent variations in stage of the lakes concerned, the discharges and laws of variation have been determined for the St. Marys, the St. Clair, the Detroit, the Niagara, and the St. Lawrence rivers. Additional work in this direction will be necessary when materially changed lake stages afford an opportunity for extending the range of observations and where recent artificial changes in outflow rivers have developed the need of more discharge measurements. Thus the building of the Gut Dam at the Galops Rapids of the St. Lawrence River in 1903 changed the outflow of the river and raised the level of Lake Ontario half a foot; the opening of the water-power canals at Sault Ste. Marie and the construction of compensating works in the rapids has changed the natural outflow of Lake Superior; the increasing withdrawal of water for



power from the Niagara River above the Falls has probably tended to lower the level of Lake Erie.

The increasing requirements of the Chicago Drainage Canal have reduced drafts on all vessel tracks on all lakes and rivers below the locks at Sault Ste. Marie. These encroachments on lake drafts point to regulation and restriction, in turn dependent upon reliable hydraulic knowledge; and the necessary data have been, and should still be, provided by the Lake Survey.

Much attention has lately been given by lake marine interests to this matter of lake levels with a view to regulation and raising the water surface, and thus affording greater draft. With a foot greater draft, giving a 10 per cent increase in cargo-carrying capacity, the freight which now cost \$50,000,000 to move should cost about \$46,000,000. The difference, capitalized at 4 per cent, shows the value of the foot added to the surface level to be \$100,000,000. This is merely a somewhat approximate statement showing the practical utility of the hydraulic investigations of the Lake Survey, which has collected the reliable available data for the determination of such matters. It is of the highest importance that this work be extended and completed.

Summing up the foregoing pages, the lakes must properly be considered the right of way, under Government ownership, of a great transportation system. The private investment in American vessels is upward of \$125,000,000, and in terminal docks and facilities many millions more. This waterway permits the movement of freight, last year aggregating over 75,000,000 tons, at a cost of one-third rail rates, netting the nation in dividends, or savings, over \$100,000,000 in the past year, which yearly saving is in excess of the nation's total investment in exploring and improving the right of way. The large commercial interests involved and the profitability of the waterway to the nation, and its great area and length of trackage, warrants a full engineering organization to explore, improve, and maintain it. The present organization consists of seven engineer districts, mainly charged with improvements in the rivers and harbors, and the engineering force at large—which is the Lake Survey—dealing mainly with the large open lake areas, and with questions relating to the betterment of the lake levels and safeguarding the carriers.

With the present yearly growing size and draft of the carriers and the expansion of commerce, while important examinations are still incomplete, the Lake Survey should be operated at its full capacity under a general project.

The areas needing especial attention are those where the traffic becomes dense and concentrated and where the water is not deep and the formation of the bottom indicates probable obstructions, namely, the east end of Lake Superior and the waters around Isle Royal, the south end of Lake Michigan and the north end of the same lake from Manitou Islands to the west entrance of the Straits of Mackinac, the Straits of Mackinac and eastward to the international boundary, the two ends of Lake Erie, and the east end of Lake Ontario, including the head of the St. Lawrence River. In addition, sounding and possibly sweeping are needed along the shores of the lakes at certain localities insufficiently covered by the earlier work of the Survey. Such localities are the south shore of Lake Superior from Sand Island



west to Port Wing, Grand and Little Traverse bays, the Keweenaw Peninsula, and south shore of Lake Superior west of Whitefish Point, west shore of Lake Michigan from entrance of Green Bay to vicinity of Chicago, south and west shore of Lake Huron from Cheboygan to Alpena, west shore from Alpena to Saginaw Bay, Saginaw Bay, and down to Port Huron. The earlier surveys did not go largely into deep-sea sounding. This is necessary to develop the general configuration of the bottom and to save the more costly sweeping by fixing by positive evidence the localities where shoals not now known may perhaps exist, these shoals having the general character of submerged hills. Deep-sea sounding should be systematically done on all the lakes.

The triangulation work of the earlier surveys was of unprecedented magnitude and difficulty and was done with an accuracy worthy of the highest praise. Due to the densely wooded character of the shores and to the smoke of numerous forest fires, it was found to be impossible at that time without excessive cost always to extend the triangulation along the lake shores, where the stations should stand in order to permit topography and hydrography to be accurately located. In recent years considerable work has been done in extending the primary triangulation to the lake shores by means of secondary and tertiary systems, and the newly devised method of water triangulation promises to greatly reduce the cost of filling in the remaining gaps, which are as follows: From Whitefish Point to Grand Island, Lake Superior; from Sturgeon Bay to Milwaukee, Lake Michigan; from Pyramid Point to Indiana State line, Lake Michigan, and from Port Austin, Lake Huron, to mouth of the Detroit River.

As previously stated, physical and hydraulic investigations of the lakes and of all the outflow rivers should be continued so as to extend the value and range of the observations.

A small amount of precise-level work is needed in order to close the existing work and to permit its proper adjustment. This closure should be carried from Escanaba to Marquette and from Monroe to Michigan City.

Finally, lake navigators are demanding the most accurate data as to magnetic variations for compass errors, and therefore work on magnetics should be continued so as to furnish additional data.

Sounding is therefore necessary over an area of 9,645 square miles, of which 2,610 miles should be swept. In addition, an area of 50,900 square miles should be covered with deep-sea sounding. A total of 1,600 linear miles of shore-line topography should be taken, with an area of 819 square miles. The remaining triangulation needed is 695 linear miles. The precise-level lines remaining to close the net are 270 miles long.

In addition to these surveys in areas specifically stated, the prompt examination of areas where vessels report obstructions should be continued as heretofore, and some small amount of work done in perpetuating the monuments of the old triangulation.

The work covered by the descriptions of the preceding paragraphs, the issue of new and the revision of old charts, and the preparation and issue of necessary bulletins constitute, then, the general project for future work of the Lake Survey.

During the year the main work of the Survey was conducted until July 31, 1906, by Lieut. Col. J. L. Lusk, Corps of Engineers; from that date to April 20, 1907, by Col. G. J. Lydecker, Corps of Engineers, and after April 20 by Maj. Charles Keller, Corps of Engineers, in charge of the principal office of the Survey at Detroit, Mich. Nearly the whole work of conducting surveys and water-level observations, reducing the results thereof, and of correcting and issuing charts and bulletins devolved upon that office. The district engineer officers rendered important aid by making local surveys and by regularly supplying valuable information for correcting the charts, bulletins, and supplements. These district officers are located at Duluth, Minn.; Milwaukee, Wis.; Chicago, Ill.; Grand Rapids, Mich.; Detroit, Mich.; Cleveland, Ohio, and Buffalo, N. Y., with suboffices at Sault Ste. Marie, Mich., and Oswego, N. Y.

During the early months of the present fiscal year seven parties were in the field, viz:

One party at Niagara Falls, engaged in extending surveys of the Niagara River from Echota to Lake Ontario, examining the approach to the mouth of the Niagara River, and also engaged in hydraulic work relative to the effect on the river, lake, and Falls of the abstraction of water for power purposes.

Two parties engaged in effecting a crossing of the north end of Lake Michigan with the primary triangulation. During the progress of this important work, soundings and topography were secured in the north end of Green Bay.

The first of these parties, after completing work in Green Bay, made soundings, using the steamer *Search*, in Lake Michigan off Sleeping Bear Point, in the Straits of Mackinac, and in the vicinity of Sturgeon Bay, Wisconsin. Much topography was also secured.

The second of these parties continued triangulation on the east shore of Lake Michigan.

A party quartered on the small steamer *No. 1* completed the surveys of Grand Haven and Holland harbors and the lower Saginaw River.

A fifth party, with the steamer *Surveyor*, was engaged on surveys at the west end of Isle Royal, at Marquette, near Gull Rock, and at Munising, Lake Superior.

A sixth party continued the primary triangulation down the west shore of Lake Huron, across Saginaw Bay, joining on the work of 1857 at Sand Point, and continuing to Port Austin, and with station erection southward.

A seventh party made observations on magnetic conditions as affecting mariners' compasses in Lake Superior from Point aux Pins to Pigeon River, mainly on outlying rocks and islands.

Since early in May four parties have been in the field and are engaged in the following work:

One party is at Niagara Falls engaged in the hydraulic investigations needed for determining the present and probable future effect of power diversion upon the American Falls. This party has established automatic gauges at Buffalo, Chippewa, Suspension Bridge, entrance of Power Canal, and Whirlpool Rapids, has taken float observations on the Canadian side, and has selected a good gauging station on the American side, where it is hoped soon to begin current measurements.

The second party has been working in the west end of Lake Erie east of Colchester light with a view to extending and widening the belt over which sweeping has been carried. For this party the weather has been unusually unfavorable, but some valuable results have been obtained.

The third party has been engaged in sweeping off Thunder Bay Island, where an oft-reported shoal has given navigation good ground for apprehension. This party has swept and sounded 19 square miles.

The fourth party has completed a survey of the harbor of South Haven, Mich., and has begun that of the harbor of St. Joseph, Mich.

The execution of the survey which terminated in 1882 involved a great quantity of astronomic, topographic, and hydrographic work, all of which was performed with a high degree of skill and accuracy. The result was the preparation of a series of reliable charts for lake vessels and the furnishing of a basis for works of channel improvement upon the lakes themselves and their connecting waters. This original series consisted of 76 charts, all of which were printed in black from copperplates.

The extensive revision of the charts now under way has for its object to show to date the changes, due to natural and artificial agencies, which have taken place in the formerly existing conditions as charted, and to furnish the additional information concerning the greater depth which the present requirements of commerce demand.

As a result of revisions, cancellations, and additions to the original series, based on the later surveys, there are now in force 114 lake survey charts, of which 4 are in black from old copperplates, 68 are lithographs in colors from copperplate transfers, 39 are lithographs in colors from stone engravings, and 3 are photolithographs in colors.

The charts issued in colors have all depths of 18 feet and less in blue, showing at a glance where vessels may proceed with safety, and are considered by vesselmen much preferable to the old style printed in plain black and white. This new series of colored charts is believed to constitute a distinct advance in chart construction and printing, and meets with high favor from navigators and others.

During the year the Detroit office has revised, transferred to stone, and printed editions in colors from 19 copperplates, revised and printed a second edition in colors from one engraving on stone, and engraved on stone and issued in colors 7 entirely new charts of the regular series. For free supplemental issue, 5 small insets were engraved on stone and 6 others prepared in various ways. For other Government offices, 2 maps were prepared by photolithography from drawings furnished. In addition to the above, revisions of 4 copperplate charts and engravings on stone of 3 new charts of the regular series are almost completed.

Of the entire series of charts there had been issued in colors 5 on July 1, 1900; 12 on July 1, 1901; 30 on July 1, 1902; 49 on July 1, 1903; 59 on July 1, 1904; 73 on July 1, 1905; 97 on July 1, 1906; and 110 on July 1, 1907.

Up to February 20, 1890, one full set of charts was issued free to each United States registered vessel. Any additional charts furnished such vessels and all furnished for other unofficial use were sold at the uniform price of 30 cents each. On the date above mentioned the

free issue, except for official purposes of the Government, was discontinued pursuant to law, and since then the charts have been sold for all private and unofficial use at prices ranging from 5 cents to 30 cents each, the price being intended in each instance to cover only the cost of paper and printing.

Charts may be purchased at the main office at Detroit, at the Canal Office at Sault Ste. Marie, Mich., and at the United States Engineer Office in Buffalo. Complete sample sets may be seen at the United States Engineer Offices at Duluth, Milwaukee, Chicago, Grand Rapids, Cleveland, and Oswego, enabling purchasers to select exactly the charts they wish to order.

From 1882 to June 30, 1907, a total sum of \$27,246.58 was derived from the sale of charts by the Detroit office and deposited in the United States Treasury.

During the fiscal year ending June 30, 1907, the number of charts sold by the Detroit office was 13,795, and by the Buffalo office 2,845, the aggregate sales being 16,640. The proceeds of the sales, amounting to \$2,616.97, were deposited to the credit of the Treasurer of the United States. The Detroit office issued 3,115 charts for official use and the Buffalo office 45, a total of 3,160. To date nearly 340,000 of these charts have been sold and issued for actual service.

The operations described call for extensive surveys and a vast amount of office work, all of which must be done with great care and accuracy. They are now being prosecuted with a small force. To secure a satisfactory rate of progress will require an expenditure of at least \$115,000 during the year ending June 30, 1909.

In addition to work relating to charts, the Detroit office continued operations under the project adopted in 1898 for an exhaustive investigation of lake levels, as described in the Annual Report of the Chief of Engineers for that year, pages 3774-3776. The principal field work of the year comprised lake temperature observations and the maintenance on the several lakes of 13 self-registering water gauges which supply an accurate and continuous record of the most minute changes in the elevation of the water surface. In Appendix III of this report will be found a table giving the discharges of all the Great Lakes at the mean stage of each for the past forty-six years, as determined from the monthly means shown on the plate in the same appendix. This work is now fully organized and it is highly important that it be pushed to completion as rapidly as possible. For this purpose the sum of \$10,000 should be made available for expenditure during the fiscal year ending June 30, 1909.

It is therefore recommended that the appropriation for that year be made to include the two amounts indicated above, and that it be formulated as follows:

*Estimate for the fiscal year ending June 30, 1909.*

For survey of Northern and Northwestern Lakes, including all necessary expenses for preparing, correcting, extending, printing, and issuing charts and bulletins, and of investigating lake levels with a view to their regulation, to be immediately available and to remain available until expended, \$125,000.

July 1, 1906, balance unexpended.....	\$135,893.09
Amount appropriated by sundry civil act of March 4, 1907.....	75,000.00
Collections credited to account:	
Receipts from sale of old boiler.....	\$150.00
Work done for other engineer districts.....	278.97
Refundment account of loss of property.....	1.28
Refundment account of overpayment.....	1.30
	<hr/> 431.55
	211,324.64
June 30, 1907, amount expended during the fiscal year.....	<hr/> 136,857.68
July 1, 1907, balance unexpended.....	74,466.96

*Bulletins.*—The preparation and issue of the series of bulletins, supplementary to the charts, commenced in 1889, relating to the river and harbor improvements and navigation of the Great Lakes, was formerly done by this office, but was transferred to the Detroit office in 1902. Of Bulletin No. 17, the last issued there, about 2,300 copies have already been distributed to the marine interests, and requests for it are constantly being received. These bulletins are issued annually, with monthly supplements through the season of navigation, and give the latest and fullest descriptions of the progress in works of river and harbor improvements intended to benefit the navigation of the Great Lakes and their connecting waters, and the results of surveys in those waters made under the direction of the Detroit office of the Lake Survey and the district engineer officers. Small maps showing locations of new shoals, changes in important channels, harbors not otherwise charted, etc., are inserted in both bulletins and supplements as occasion arises.

*Annual water levels of the Northern and Northwestern Lakes.*—A table showing the monthly water levels from July 1, 1906, to June 30, 1907, at Marquette, Mich., on Lake Superior; Milwaukee, Wis., on Lake Michigan; Sand Beach, Mich., on Lake Huron; Cleveland, Ohio, on Lake Erie, and Charlotte, N. Y., on Lake Ontario, will be found in Appendix I I I.

(See Appendix I I I.)

#### THE CONTROL AND REGULATION OF THE WATERS OF NIAGARA RIVER AND THE PRESERVATION OF NIAGARA FALLS.

In connection with applications for permits under the act of Congress of June 29, 1906, "For the control and regulation of the waters of Niagara River, for the preservation of Niagara Falls, and for other purposes," the Secretary of War directed in his memorandum of July 14, 1906, that Capt. Chas. W. Kutz, Corps of Engineers, should institute, under the direction of the Chief of Engineers, an investigation of conditions existing at Niagara Falls.

Captain Kutz submitted a report August 15, 1906, concerning the power companies on the Canadian side (published in War Department Doc. No. 284), and a report October 5, 1906, concerning the power companies on the American side (published in War Department Doc. No. 289).

During the season of 1906 a party engaged in the work of surveying the river in connection with the Survey of the Northern and Northwestern lakes made observations of current lines and velocities and

fluctuations of water surface, redetermined the crest line of the two cataracts, and secured a series of photographs showing the appearance of the rapids and cataracts under widely varying volumes of flow. These operations are further described in connection with the Lake Survey report, Appendix III.

In his opinion of January 18, 1907, the Secretary of War directed the Chief of Engineers and Captain Kutz to prepare permits for the diversion of water from the American side and for the transmission of power from Canada, and it was also directed that Captain Kutz be detailed to report a plan for the supervision of operation under the permits. Questions connected with the preparation of permits and with the supervision of operations were under consideration at the close of the fiscal year.

March 20, 1907, Capts. John S. Sewell and Charles W. Kutz, Corps of Engineers, were detailed by the Secretary of War as additional members of the committee, consisting of Messrs. C. F. McKim, Fred-eric Law Olmsted, and Frank Millett, appointed by the Secretary of War in connection with the preservation of natural scenic effects at Niagara Falls.

March 20, 1907, the Secretary of War approved a recommendation of the Chief of Engineers that the officer in charge of the Survey of the Northern and Northwestern Lakes be authorized to make such observations and to carry on such operations as may be necessary to determine whether the diversion of the authorized amount of 15,000 cubic feet per second from the American side in connection with that to be diverted on the Canadian side for the development of 160,000 horsepower injures or interferes with the navigable capacity of said river or with its integrity and proper volume as a boundary stream or with the scenic grandeur of Niagara Falls, and the sum of \$5,000 was allotted for the investigation. A project dated April 30, 1907, covering the necessary operations was approved by the Chief of Engineers May 8, 1907, and a Lake Survey party organized for the purpose left Detroit for Niagara Falls May 20, 1907. The operations of that party to the close of the fiscal year are described in connection with the report of the Survey of the Northern and North-western lakes, Appendix III.

In addition to the expenditures made in connection with the Lake Survey operations under the project of April 30, 1907, the sum of \$3,849.32 has been disbursed by Capt. W. J. Barden, Corps of Engineers, disbursing officer of the Office of the Chief of Engineers, for expenses connected with hearings before the Secretary of War, for expert services, and for traveling expenses.

Amount appropriated by act of June 29, 1906.....	\$50,000.00
June 30, 1907, amount expended during fiscal year.....	4,306.98
July 1, 1907, balance unexpended.....	45,693.02
July 1, 1907, outstanding liabilities <sup>a</sup> .....	685.98
July 1, 1907, balance available <sup>a</sup> .....	45,007.04

<sup>a</sup> The question of pay of the civilian members of the committee appointed by the Secretary of War, in connection with the preservation of natural scenic effects at Niagara Falls, yet to be determined.

IMPROVEMENT OF THE YELLOWSTONE NATIONAL PARK, INCLUDING  
THE CONSTRUCTION, REPAIR, AND MAINTENANCE OF ROADS AND  
BRIDGES.

Officer in charge, First Lieut. E. D. Peek, Corps of Engineers.

The Yellowstone National Park was set apart from the public domain and placed under the control of the Secretary of the Interior by act of Congress of March 1, 1872. The sundry civil act of March 3, 1883, directed the construction and improvement of suitable roads and bridges under the supervision of an engineer officer to be detailed by the Secretary of War, and in July, 1883, an engineer officer was designated accordingly. This was the beginning of systematic road construction in the Park. The previous work consisted of the opening of such rough trails as the limited means permitted, but they were temporary in character and of little or no value in the permanent plan. Subsequent to the sundry civil act of August 4, 1886, the expenditure for the improvement was transferred to the War Department, and it has been in the charge of the Engineer Department with the exception of the period from August, 1894, to March, 1899.

At the outset the officer of the Corps of Engineers in charge adopted a project (described in the Annual Report of the Chief of Engineers for 1887, p. 3134) for a comprehensive system of substantial roads which, with the change of the act of Congress of March 3, 1891, is the basis of the present system. The sundry civil act of June 6, 1900, directed that the road extensions and improvements should thereafter be made in harmony with a general plan to be approved by the Chief of Engineers. Such plan was approved August 27, 1900, modified by authority of the Secretary of War, dated July 22, 1901, and further modified by approval of the Chief of Engineers, dated July 2, 1902. The sundry civil act of June 28, 1902, recognized this project and provided for its completion, and it was practically finished during the fiscal year ending June 30, 1906. It comprises a belt line or main circuit which reaches all of the important centers of interest, with side roads, bridle trails, and four approaches leading from the park boundary to different points on the belt line—in all, about 350 miles of road and about 125 bridges. The sum expended to June 30, 1907, including maintenance and repairs, is \$1,713,521.42. It is estimated that not less than \$200,000 of this amount was expended in early work which has since been replaced and does not form a part of the completed system. Maintenance and repairs have cost about \$435,852.25, leaving about \$1,077,669.17 for the cost of the permanent work. In addition, there has been expended on work done for other Departments the sum of \$850.95, for which the Park appropriation has been reimbursed.

The sundry civil acts of June 30, 1906, and March 4, 1907, provided funds for the maintenance and repair of improvements, and projects for the expenditure were approved July 17, 1906, and April 8, 1907. The work of the past fiscal year under these projects included:

General repair and maintenance of the entire system, including the Cooke City, East, West, and South roads; the construction of a road to the petrified tree stumps in the vicinity of Yanceys, and the excavation of the rock surrounding one of the stumps; repairs to bridges; the replacing of Sulphur Creek bridge by a culvert and fill; laying of tile culverts; construction at a number of points of platforms for the loading and unloading of coaches; construction



of platforms and stairways in the Canyon, of outhouses at several places, and of three houses on the Divide for working crews; the clearing of dead and falling timber from the roadside; 100 miles of road sprinkled, a number of pumping stations converted into gravity tanks, and hydraulic rams installed; repairs to sprinkling wagons, road graders, carts, and other vehicles; the purchase of a portable planer and the dressing of lumber; maintenance of trees, shrubs, vines, and lawns; the erection of a fence at Hymen Terrace, and of an iron fountain in front of the residence of the United States Commissioner; care of the alfalfa field at Gardiner (since transferred to the charge of the superintendent of the Park); the purchase of about 600 enameled-steel signs; the survey of a road to connect the Canyon and Tower Falls, and a survey, in progress, for a road from the west boundary of the Park, at the crossing of the Gallatin River, to a point on the Norris road about 7 miles from Mammoth Hot Springs.

It is proposed to apply the \$200,000 estimated as a profitable expenditure during the fiscal year ending June 30, 1909, to work of maintenance and repair, together with the replacing of dry retaining walls with mortar or concrete, the replacing of certain wooden bridges with steel, and commencing the work of resurfacing the system, including the purchase of the plant necessary therefor. The work is necessary to keep the improvement available for use.

More extended information relating to previous operations is published in the Annual Reports of the Chief of Engineers, as follows:

- 1887, page 3133. A résumé of operations from 1883 to 1887.
- 1900, page 5420. A general résumé covering the period 1872-1900.
- 1900, page 5441. The general plan approved August 27, 1900.
- 1901, page 3797. Modification of 1901 in the general plan of August 27, 1900.
- 1903, page 2444. General description and technical details of work.
- 1905, following page 2822. Map of tourist routes.

July 1, 1906, balance unexpended.....	\$60,615. 10
Amount appropriated by sundry civil act approved March 4, 1907....	75,000. 00
	<hr/>
	135,615. 10
June 30, 1907, amount expended during fiscal year.....	78,171. 51
	<hr/>
July 1, 1907, balance unexpended.....	57,443. 59
July 1, 1907, outstanding liabilities.....	17,783. 41
	<hr/>
July 1, 1907, balance available.....	39,660. 18
	<hr/>
Amount that can be profitably expended in fiscal year ending June 30, 1909, for maintenance and repairs, in addition to the balance unexpended July 1, 1907.....	200,000. 00

(See Appendix J J J.)

#### ROAD INTO MOUNT RAINIER NATIONAL PARK.

Officer in charge, Maj. H. M. Chittenden, Corps of Engineers.

Prior to the commencement of operations, an inferior road led into the park from the western boundary of the forest reserve to Longmire Springs, a distance of about 10½ miles, and rough trails extended thence to the Camp of the Clouds.

The sundry civil act of March 3, 1903, appropriated \$10,000 for a survey of the most practicable route for a wagon road into the park and for commencing construction. An estimate of cost, amounting to \$183,000.50, was submitted to Congress March 22, 1904, and printed in House Document No. 631, Fifty-eighth Congress, second session, and an appropriation for continuing construction was made in the sundry civil act of April 28, 1904. The project thus authorized by Congress



and the one under which work is being carried on contemplates the construction of a wagon road from the western boundary of the forest reserve to the Camp of the Clouds, a distance of about 25 miles.

Under the contract with A. D. Miller, which was annulled June 12, 1906, about 1 mile of road was constructed immediately above Longmire Springs. Work has been carried on during the past year by hired labor and use of Government plant, and about 7 miles of road were completed, all between the western boundary of the forest reserve and Longmire Springs, making the total length completed about 8 miles.

The total amount appropriated to date is \$140,000, of which \$17,216.23 were expended on surveys. The amount expended on the work of the existing project up to the close of the fiscal year ending June 30, 1907, is \$65,703.63.

It is proposed to use the amount estimated as a profitable expenditure during the fiscal year ending June 30, 1909, in constructing the road above Longmire Springs, thus increasing the extent of the improvement available.

The report of the field work of the original survey made in 1903 is printed in the Annual Report of the Chief of Engineers, 1904, page 4207. The general location of the proposed route is shown on the map of the survey made in 1904 for a proposed additional road into the park from the east, printed in House Document No. 283, Fifty-eighth Congress, third session.

July 1, 1906, balance unexpended.....	\$63, 404. 74
Amount appropriated by sundry civil act approved March 4, 1907...	50, 000. 00
	<hr/> 113, 404. 74
June 30, 1907, amount expended during fiscal year, for works of improvement.....	56, 324. 60
July 1, 1907, balance unexpended.....	57, 080. 14
July 1, 1907, outstanding liabilities.....	10, 900. 00
July 1, 1907, balance available.....	<hr/> 46, 180. 14
Amount (estimated) required for completion of existing project....	<hr/> 75, 000. 00
Amount that can be profitably expended in fiscal year ending June 30, 1909, in addition to the balance unexpended July 1, 1907, for works of improvement.....	50, 000. 00
(See Appendix K K K.)	

#### MAPS, WAR DEPARTMENT.

With the \$3,000 appropriated for this purpose for the fiscal year ending June 30, 1907, agreements have been entered into for the printing of five harbor charts for the use of the Coast Artillery. A map has also been printed for the Department of Dakota, and a portion of the cost of maps for use in connection with maneuvers of the militia has been paid from this appropriation.

Existing regulations require the commanding officer of each post where there are fixed batteries bearing upon a channel to call upon the Engineer Department for accurate charts showing the soundings to the extent of the ranges of the guns. A number of these charts

will be required during the fiscal year 1909. It is recommended that \$5,000 be appropriated for this purpose, and an estimate of that amount is submitted.

BUILDINGS, ARMY WAR COLLEGE, WASHINGTON, D. C., AND ENGINEER SCHOOL, WASHINGTON, D. C.

Officers in charge, Capt. John S. Sewell, Corps of Engineers; Maj. Chester Harding, Corps of Engineers, in charge of new work since March 16, 1907.

The creation of the Engineer Post and School at Washington Barracks was authorized by an act of Congress approved June 30, 1902, based on an estimate prepared without funds available for the preparation of detailed plans or for the making of borings, etc. This estimate contemplated the utilization of a number of existing buildings, and provided for construction of new buildings inclosing approximately 4,000,000 cubic feet. A unit price of about 16 cents a cubic foot of space inclosed in buildings, all contingencies included, was practically the basis of this original estimate. Further development of plans for the Engineer Post, and for the War College building authorized in the same act, led to the approval by the Secretary of War of a transposition of the locations of the two, so that the latter building now occupies the site originally planned for the Engineer Post. This change led eventually to the abandonment of the effort to utilize old post buildings, which, upon detailed examination, proved also to be in such bad condition as to make repairs expensive and not economical. These facts were reported in general terms in the Annual Report for 1904, page 741, as well as the fact that the Subsistence Department had utilized the post for a distributing depot, which was not anticipated in the original estimates. The army appropriation act approved June 12, 1906, provided a chaplain for the Corps of Engineers, who has been assigned to station at this post, and a commissary officer has been assigned to permanent station there, both calling for additional quarters.

In view of these and other similar minor changes the cubic contents of the buildings actually provided were increased by increasing the number of buildings as far as funds would permit, actual construction having been almost exactly as costly per cubic foot of inclosed space as the estimate.

The condition of the work at the close of the fiscal year was as follows:

BUILDINGS, ARMY WAR COLLEGE.

This work is entirely finished and the accounts all settled up. For detailed history of this work, reference is made to the Annual Reports of the Chief of Engineers for the years 1902, 1903, 1904, 1905, and 1906.

Amount appropriated by act of June 30, 1902.....	\$400,000.00
Amount appropriated by act of April 23, 1904.....	300,000.00
Amount of Treasury transfer for mileage refunded to appropriation .....	187.04
	<hr/>
	700,187.04
June 30, 1907, amount expended to date.....	699,194.12
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July 1, 1907, balance unexpended.....	992.92
July 1, 1907, outstanding liabilities.....	992.92

## BUILDINGS, ENGINEER SCHOOL.

All the work authorized under appropriations made for this object up to and including the act of March 2, 1905, has been completed and the accounts for those appropriations have been finally settled up. For detailed history of this project reference is made to the annual reports of the Chief of Engineers for the years 1902, 1903, 1904, 1905, and 1906.

In the Army appropriation act approved March 2, 1907, funds were appropriated for additional work under this project as follows: For completion of two incomplete sets of noncommissioned officers' quarters, \$15,000; for construction of one new stable, \$17,500. Plans and specification for these buildings are nearing completion, and work of actual construction will be commenced early in the fiscal year 1908. This new work was assigned to the charge of Maj. Chester Harding, Corps of Engineers, on March 16, 1907.

On December 22, 1904, the Secretary of War approved a general layout which, it is thought, completely meets the present needs of the post and school; a drawing of this proposed post accompanied the report of Captain Sewell published in the Annual Report of the Chief of Engineers for 1906. Additional buildings are shown on this sheet; arranged in the order of their immediate importance, and with the estimated cost of each stated, they are as follows: A building or buildings, for post headquarters, engineer school, engineer library, engineer museum, etc., \$350,000; barrack No. 2 (completing), \$35,000; six additional double sets of quarters for noncommissioned officers' quarters, \$60,000; new post hospital, \$60,000; bachelor officers' quarters, \$65,000; one new stable, \$17,500; engineer school power house, \$20,000; engineer school trade shops, \$20,000; quartermaster's coal shed, \$8,000; timber shed, \$3,000; quarters for chaplain, \$17,000; extending and completing the system of roads, sidewalks, sewers, water supply, gas, and electrical distribution to serve these new buildings, \$25,000; field observatory, \$3,000; contingencies, \$71,600; in addition there is urgently required a storage shed for ponton wagons, which is estimated to cost \$12,500; total, \$767,600, or, in round numbers, \$770,000. An estimate of this amount is submitted.

Fuller details of these new buildings and their objects are given in the report of Captain Sewell, published as Appendix H H H of the Annual Report of the Chief of Engineers for 1906.

It is recommended that Congress provide for as many of these items at the coming session as the general condition of the public funds may justify, with a view to the early completion of the post and school.

Amount appropriated by act of June 30, 1902-----	\$500, 000
Amount appropriated by act of March 2, 1903-----	360, 000
Amount appropriated by act of March 2, 1905-----	150, 000
Amount appropriated by act of March 2, 1907-----	32, 500

June 30, 1907, amount expended to date-----	1, 042, 500
	1, 010, 000

July 1, 1907, balance unexpended-----	32, 500
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(See Appendix L L L.)

CONSTRUCTION OF BRIDGE ACROSS MISSISSIPPI RIVER BETWEEN  
FORT SNELLING RESERVATION AND ST. PAUL, MINN.

This work was in the charge of Lieut. Col. George McC. Derby, Corps of Engineers, to November 17, 1906, and in the temporary charge of Col. James B. Quinn, Corps of Engineers, from November 17, 1906, to June 7, 1907, and of Capt. E. H. Schulz, Corps of Engineers, since June 7, 1907.

The act of Congress approved March 17, 1906, provided for the construction of the bridge at a limiting cost of \$250,000, toward which was to be paid not less than \$100,000 by the city of St. Paul, not less than \$25,000 by any electric street railway company receiving right of transit across the bridge, and such sum as the Secretary of War might determine by any steam railway company hereafter using the bridge.

The sum of \$100,000 has been secured to the United States by the city of St. Paul, and the sum of \$25,000 has been paid by the Twin City Rapid Transit Company for the right of transit across the bridge.

A site has been selected for the proposed bridge, with the approval of the Secretary of War, about 300 feet below the old Fort Snelling bridge.

Amount expended to June 30, 1907, \$4,128.43.

During the year the site was surveyed and borings made to determine the character of the foundation. Part of the land required for approaches was purchased. The balance of the land needed will probably have to be obtained by condemnation proceedings. Proposals have been issued and bidders asked to submit plans and specifications. The bids will be opened July 19, 1907.

Amount received from Twin City Rapid Transit Company-----	\$25,000.00
Amount appropriated by sundry civil act approved March 4, 1907-----	125,000.00

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150,000.00

June 30, 1907, amount expended during fiscal year, for works of improvement-----	4,128.43
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July 1, 1907, balance unexpended-----	145,871.57
July 1, 1907, outstanding liabilities-----	36.50

July 1, 1907, balance available-----	145,835.07
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(See Appendix M M M.)

ERECTION OF MONUMENT TO COMMEMORATE THE BATTLE OF KINGS  
MOUNTAIN IN SOUTH CAROLINA.

This work was in the charge of Capt. G. P. Howell, Corps of Engineers.

By act of Congress approved June 16, 1906, the erection of a monument on Kings Mountain battle ground to commemorate the victory of the war of the American Revolution, October 7, 1780, was authorized, and \$30,000 appropriated. The construction was assigned by the Secretary of War to the Engineer Department. During the year the title to the land has been determined by the Attorney-General of the United States, to rest with the Kings Mountain Centennial Association of South Carolina, and bids for the erection will shortly be issued.

July 1, 1906, balance unexpended.....	\$30,000.00
June 30, 1907, amount expended during fiscal year, for works of improvement.....	72.23
July 1, 1907, balance unexpended.....	29,927.77

ERECTION OF MONUMENT TO THE MEMORY OF SOLDIERS WHO FELL  
IN THE BATTLE OF NEW ORLEANS, IN THE WAR OF 1812.

This work was in the charge of Capt. J. F. McIndoe, Corps of Engineers.

By act of Congress approved March 4, 1907, Congress appropriated \$25,000 for the completion of a monument to the memory of the soldiers who fell in the battle of New Orleans in the war of 1812. The design of the monument was approved by the Secretary of War May 17, 1907, and the work of construction and disbursement of funds assigned to the Engineer Department. The site of the structure is at Chalmette, La.

To June 30, 1907, no expenditures had been made.

OFFICE OF THE CHIEF OF ENGINEERS.

During the fiscal year ending June 30, 1907, the following-named officers were on duty in this office as assistants:

Lieut. Col. Frederic V. Abbot.

Maj. Harry F. Hodges.

Capt. Charles W. Kutz, until October 12, 1906.

Capt. William J. Barden.

Very respectfully,

A. MACKENZIE,

*Brig. Gen., Chief of Engineers, U. S. Army.*

THE SECRETARY OF WAR.

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